ENGINEERING NEWS

IN connection with the soft-ground work at Shaft 17 on the New Croton Aqueduct, described in our issue of August 13, we have received a letter from Mr. DENNIS S. DOYLE, who says he was in complete charge of that work under a special agreement with the contractors proper. Mr. DOYLE complains that while he was solely responsible for the way in which the heading was carried on, Mr. THOMPSON, the Engineer-in-Charge, obtained all the credit for the same in our article, and accuses Mr. THOMPSON of unfairness in his neglect to mention the name of the one who really did the work. In answer to this we would say that the account published was not written by Mr. THOMPSON, but by our own special reporter who gathered his information on the aqueduct as best he could. We know from long experience that the claims of the hard-working miner, whose skill and practical knowledge is generally at the bottom of successful work of this nature, is too often overlooked, and this is the case as often from modesty on the part of the miner as from any intent or forgetfulness in the engineer-in-charge. So, while rather late, we wish to give Mr. DOYLE all the honor that belongs to him in this connection for a very pretty piece of tunneling.

Messrs. CARNEGIE BROS. & Co., of Pittsburg, Pa., have succeeded in making a ton of pig-iron with 2,000 cu. ft. of natural gas in specially constructed furnaces, where formerly 5,000 to 7,000 cu. ft. were required.

OUR correspondent, F. A. S., whose letter on the Panama Canal appeared last week, writes us that he did not wish to there imply that 50,000 men should attack the Culebra cut, as the letter would make it appear. But that this number of workmen was to be scattered over the whole line. He says that at the utmost not more than 4,000 men could be worked to advantage at the Culebra alone.

THERE is still talk of the new bridge across the St. Lawrence river at Quebec. As described now the bridge would cross the 3,300 ft. of river at this point by three main spans, with a central one of 1,490 ft. and two side spans of 470 ft. each. The clear headway above water would be 147 ft. The Montreal *Star* says that it is "almost certain to be built shortly," as a large sum of money has been subscribed. Sir ADOLPHE CARON and Mr. MCGREEVY are looked upon to forward the scheme.

THE extensive bridge works of Morse Bros., near Youngstown, Ohio, were totally destroyed by fire on Aug 27. The works employed 300 men and the total loss is estimated at $100,000 with an insurance of $98,000. The works will be rebuilt at once.

THE Standard Oil Company is said to have approved plans for a fleet of steamers which they expect to built shortly for the export of oil in bulk. Each of these tank steamers will carry 700,000 galls. of oil and make the trip to European ports in 14 days.

Mr. ARROL, the builder of the new Tay bridge, is demolishing the former Tay bridge piers of brick by an old but effective method. Cuttings are made in the brickwork and filled with wooden blocking. This wood is then set on fire, and as the blocks burn and lose their bearing value the masonry collapses and falls into the water. Suspicion of bad work in the massive old piers seems to be corroborated by the fact that they crumble in falling instead of coming down in a single mass as they should had they been well bonded.

THE first report of Mr. J. ALPROVIDGE, the leader of a party sent out by the Delagoa Bay and East African Railway Co. to explore the country adjacent to the railway, is an original document in the minuteness with which Mr. ALPROVIDGE goes into the detail of his expedition. In 11 days he journeyed 45 miles inland from Delagoa Bay. But while telling nothing especially about the country traversed, he accounts for his daily travel to the minute, in morning starts, and noon-day halts and evening stops; describes the capers of his Kaffir attendants, his loss of oxen and donkeys and the trouble in recovering them, and shows how his evenings were passed in listening to the strain of "Two lovely black eyes" to a banjo accompaniment. In justice to Mr. ALPROVIDGE it should be remarked that he had not yet "selected a permanent location for the party destined to explore this part of the country."

BY the erection of the Sukkur bridge in the Isle of Dogs before sending the ironwork to India, it has been proved that the bridge will stand, and it is said that the designer is pleased to find that this is the case.—*The Engineer.*

What's the matter with this Sukkur bridge anyhow? We had some remarks to make upon it last week, and are now glad to see that our English contemporary recognizes in a certain degree the folly of such an expensive method of testing the theories of a bridge designer. The better plan would have been to have originally secured the services of an engineer whose ideas on bridge construction did not require "24 lineal miles of false works" to prop them up.

AND now we are to lose the Chinese Wall, so familiar to every school-boy, and so often quoted as a colossal example of ancient engineering enterprise. At least the Abbè LARRIEU, an ex-missionary who claims to have lived upon the reputed line of the wall for some years, declares that he can only find a few scattered towers of earth which were never connected and occasional walls which seemed to be mere village works and never to have formed part of a general scheme of defence. Perhaps the worthy Abbe lost his bearings and found "some other walls and towers." He must in any event back his assertions by something more convincing than his unsupported personal dictum before we can permit him to consign our dear old wall to that limbo which already contains what is left of the "Great American Desert," the Mountains of the Moon and some other familiar features of our school boy days.

$30,000,000 are required to carry out the proposed improvement on the Suez canal. This amount (100,000,000 francs) is to be raised by the issue of a 3 per cent. bond, yielding 15 francs per annum and sold to existing stockholders for 380 francs on a par value of 500 francs.

A TRAIN on the New Jersey Central Railroad had a narrow escape last week from wrecking the draw on the Newark bay bridge, and, possibly, much more serious consequences. A coal train was moving slowly over the bridge ahead of the passenger train, the locomotive of which was within a few feet of the caboose of the other train. Just as the passenger train had passed half way on the draw the man in charge, seeing a steamboat coming, began to turn the draw, but was unable to move it more than five or six inches owing to the weight of the car lying across its connection with the bridge. The couplings creaked and groaned under the strain but successfully withstood it. The engineer of the passenger train, seeing the danger, instantly reversed his lever and moved the train back off the bridge. Had the locomotive gone ahead a little further, the draw would, in all probability, have swung around with the train on it, the weight of which would have smashed the structure. Of course the whole proceeding was highly improper and invited disaster. No railway draw should be operated without an interlocking apparatus that would put it out of the power of a careless draw-tender to thus imperil trains and human life.

THE Pennsylvania R. R. Co., it is said, will equip a number of its important passenger trains, this winter, with steam-heating appliances. The same report says that the late tests show that a pressure of from 4 to 5 lbs. of steam from the locomotive is sufficient to maintain a uniform degree of heat in a train of 8 coaches, and that the new system is really less expensive in requiring less labor.

THE following bridge accidents are reported: On August 24 a bridge carrying the Union Pacific Railroad across Sand creek, 10 miles east of Denver, Col., was washed out. The engine and baggage car of an express train fell into the gap, and two men were killed. The bridge of the Burlington & Missouri River Railroad, which is close to that of the Union Pacific, was badly injured by the flood, but the trains were flagged in time.——On August 25, a railroad bridge at Atchison, Kan., was burned; the cause being a collision in which a car loaded with kerosene was set on fire.

THE most serious railroad accident of the week was a head collision, August 24, at Easton's Siding, about 24 miles east of Wheeling, W. Va., on the Baltimore & Ohio Railroad. A west-bound emigrant train ran into an east-bound freight, the engineer of which had misapprehended orders and, thinking he had the right of way, had just pulled out of the siding. Two men were killed, and about 15 seriously injured.

ON August 23 an east-bound express on the Baltimore & Ohio Railroad ran into a landslide at Hermitage station, 6 miles east of Connellsville, Pa. The engine and baggage car went down an embankment and the forward car was derailed. No one was injured.——Several washouts have occurred on the Portland & Rochester Railroad, one of which, near Portland, Me., caused the derailing of an engine, which collided with a bridge and seriously damaged it.

OUR late item concerning the Chinese—Philadelphia telephone, railway, banking scheme seems to be corroborated, with the banking portion of the project just now in the ascendency. The concession is said to have been obtained by the Count MITKIECWICZ, "one of the most shrewd financiers in the United States," and China is to send seven commissioners to this country to especially study our banking system with a view to introducing it into China. The present Chinese coinage is to be abandoned, and we are no longer to see that peculiar coin, which, a little like the Irishman's gun, is made by casting brass around a square hole. Philadelphia capital is to back the scheme, with the banking house of WHARTON BARKER as the leading house as reported.

AN innovation brought about by the increased height of office buildings in this city has just been introduced into the Mills Building. This is a patent mailing tube, whereby letters may be placed in an opening provided on every floor, and they at once pass to a large mail-bag in the lower story which is visited by the postman on every tour.

NOTWITHSTANDING the reduction in cost of fencing-in a railroad right-of-way by the introduction of the barb-wire, this item of equipment—if it can be so called—is still an expensive one. Just what this means is illustrated in the work of this nature being done on the Chicago, Kansas & Nebraska R. R. This system has 700 miles of track, requiring 1400 miles of fencing, and the contract has been made for 50 cents a rod, or $234,000 for the material and labor. The fence is made of 5 strands of wire, or 7000 miles in all; and as there is a post to each rod, the aggregate is 448,000 posts. The fencing gangs include 35 men each and each gang sets posts and strings wire at the rate of one mile per day.

IT is probably well for the present nominal head of the Baltimore & Ohio Railroad that spirits can not materialize, else we should see the substantial form of old JOHN W. GARRETT wielding a shingle in uncomfortable proximity to his ultra-fashionable but unbusiness-like son. One of the saddest pictures in the railway world of to-day is, to see this handsome old property so badly shattered by the incompetent management of a very few years. Ambition to do great deeds without the mental capacity to back up intentions, has brought about the present practical wreck. But after all, how can any man run a railroad and keep the moths out of 250 pairs of pantaloons at one and the same time.

THE Connecticut Railroad Commissioners are having an animated controversy with the railway authorities and the towns on the railways concerning grade crossings. The statutes provide that the commissioners may assess, not to exceed one-half the cost of carrying the highways over or under the railroads, upon the towns, but the towns resist. A decision of the Supreme Court of Errors of 1886, decided that grade crossings are a nuisance to be abated at the joint expense of all parties interested. But the towns maintain that as they cannot be held responsible for accidents and have no power to regulate the passage of trains they neither have a

pecuniary nor a moral interest in the matter. This puts forward a new feature that may require a special session of the Legislature to settle.

A LETTER to the *Buffalo Express* from THOS. EVERSHED C. E., gives his views in relation to the feasibility of constructing a tunnel for hydraulic purposes from below the Falls of Niagara to Buffalo, which would act as a tail-race to mills already constructed or to be constructed. The distance is 18¼ miles from the Falls to the foot of Main street, in Buffalo by the shortest line on United States territory. The tunnel would pass under the whole length of Grand Island and under the river to Main street. For the first 6 miles it would be in hard limestone rock, then for 12 miles through the Onondaga shales; many of these latter strata are quite soft and would required the tunnel to be lined with masonry. The total expense of building a tunnel equal in discharging capacity to a pipe 30 ft. in diameter, and with the necessary ramification of small tunnels, would aggregate $30,000,000. If lined with masonry in the softer portions, the cost would be $35,000,000. Mr. EVERSHED estimated that a smooth tunnel 30 ft. in diameter, and with turbines used under a 90 ft. head (as is successfully done at Rochester and elsewhere) would serve as a tail-race for about 50,000 horse-power and not for 300,000 to 500,000 horse-power as some publications have it. At the proper rating the scheme would pay but a very small income on the money expended. Mr. EVERSHED recommends that the power be used directly at Niagara, where, as he has already made public, a 25-ft tunnel 2½ miles long would generate not only sufficient power to operate works on the canal, but also run dynamos whereby power could be transmitted in the form of electricity to Buffalo. Recent experiments of the French Academy of Science showed that 200 horse-power could be transmitted 35 miles, and they actually accomplished this amount of work. Their report also demonstrated that losses became less sensible as the scale of the operation increased, and Mr. EVERSHED believes that he can thus transmit to Buffalo in large quantities a power several times cheaper than steam, and do it with a loss not exceeding 20 percent.

THE *Schweizerische Bauzeitung*, in speaking of the late land-slide at the Lake of Zug, describes the situation about as follows: Soundings taken on July 8 and compared with soundings made in 1881 show plainly that the alteration in the depth of the lake extended out nearly 1,000 ft. from the quay-wall and almost exactly over a width corresponding to the slip on the shore, viz., about 368 ft. The depression left by the slide was trough-shaped, with steep sides and a flat bottom and about 58 ft. deep as a maximum. Just at the quay-wall the sliding mass was about 33 ft. thick. The sunken area measured nearly 11,000 sq. yds., so that the mass moved from inside the quay-wall would be about 120,000 cu. yds. But as there was a flow under water as well, the whole cubē which moved was probably not far from 200,000 to 275,000 cu. yds. as indicated by the soundings. The cause given for the accident is the exceedingly mobile and slippery nature of the mud stratum underlying the land and the lake just at this point. And the immediate exciting cause was the building, in late years, of a tight quay-wall on piles without making any provision for the escape of land-water practically dammed up behind it. This water saturated the filled-in ground and started the slide in all probability.

Le Canal de Corinthe, for Aug. 12, 1887, says the canal work is "advancing rapidly." The cube extracted in 24 days of last June was 172,342 c. m., or about 7,180 c. m. per day. In July they took out 178,569 c. m. in 25 days, nearly the same daily average as before. About 2,157 men represent the effective force employed.

The Computation of Earthwork from Diagrams.

In obedience to the request of several recent correspondents we give herewith some diagrams illustrating practically the method used in Mr. WELLINGTON'S treatise on the Computation of Earthwork for performing mechanically the usual processes of earthwork computation, saving all multiplication and division. Although these diagrams have been before the public many years and are in very wide use, preparing estimates by numerical computation, with more or less assistance from tables, is still the rule, apparently for the reason that the idea of using diagrams is associated in most engineers minds with more or less indefiniteness and inaccuracy so that they have an impression that it gives a much ruder approximation to the true volume than is obtained by using lead-pencils or tables.

This is true of all the other diagram methods which we know of, but it is not at all true of the present one, except that the latter does not permit of greater minuteness than the nearest cubic yard, whereas by numerical computation one *can* figure out the volume to a thousandth of a yard, if he pleases. But when one recalls (or finds out by trial, if he does not know it) that an error of 0.1 ft. in making the cut on any stake, or a slight bellying of slopes, or starting the cut a little inside the slope-stakes (both the latter almost universal) or an error of a tenth or two in the final width or grade of roadbed or an unrecorded irregularity of the original surface will make not one, but 4 or 5 or 10 or 20 or even 50 cu. yds. difference in the resulting volume, it is apparent to every intelligent person that it is not of the slighest importance to have even a greater possible error than the cubic yard or so which is the maximum even for single solids of the diagram below, the probable error in the average of a number of solids being only a very small fraction of a cubic yard.

Moreover, this method by diagrams permits an accuracy not otherwise attainable without a vast amount of labor in applying the prismoidal formula to earthwork computation, which is done by the only proper method in any mode of computation (because much the simplest way to obtain identical results) determining a "prismoidal correction" to be deducted from the previously computed end-area volumes.

The accompanying cuts are taken directly from the volume, as also the Fig. numbers, although of course the range of the extract from a complete diagram given in Fig. 7, is very limited, since it applies to center-heights between 5 and 14 ft. only, and to center heights of a probable and undistorted form (those having some approach in area to a level section of the same center height) of from 7 to 11 ft. only. The original diagram, however, applies to every kind and form of section which is ever likely to occur from 0 to 35 ft. center height on a sheet 14 × 17 ins. in size.

The volumes due to what are called "three-level" sections, that is to say, sections which are given by a center cut (or fill) and by the cut and distance out of a slope-stake at each side, are given at a single inspection of the diagram. Irregular sections, which have one or more intermediate levels taken, or irregular earthwork of all forms, require as many inspections and readings as the number of double triangles into which the section can be divided. For example, the sections shown in Fig. 16 require three readings each. These latter readings are taken from a "Diagram of Triangular Prisms" which is of general application to every form of irregular earthwork.

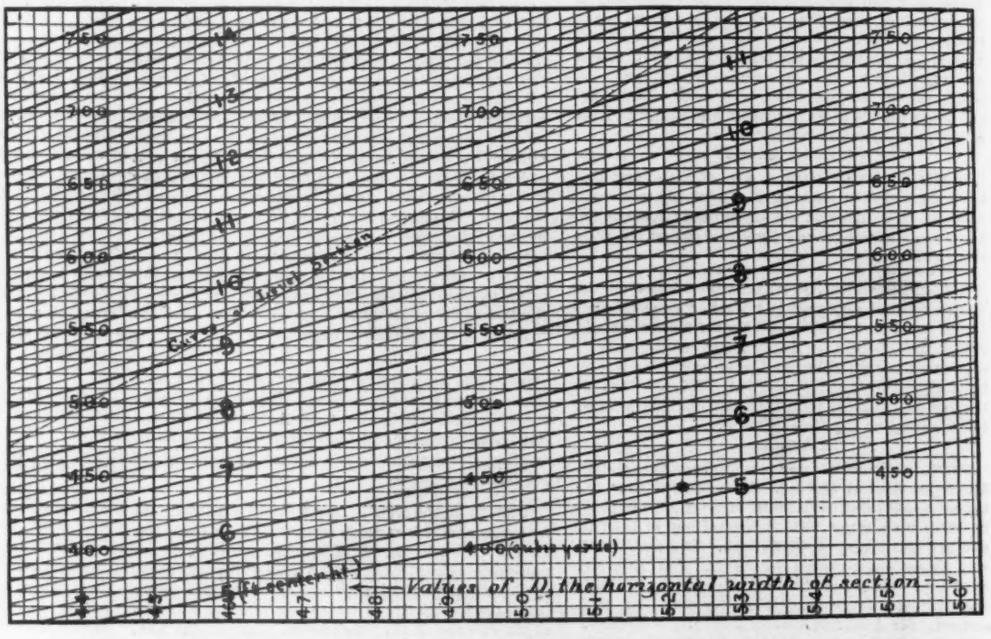


Fig. 7.—*Extract from Diagram of Cross-Sections. Road-bed, 18, Slopes 1½ to 1.*
(The original is 14 by 17 in. and applies to sections of any form up to 35 ft. center-heights, or (indirectly) to 70 ft. center-heights.)

With this explanation the following literal extracts from the volume will give a sufficient idea of the process in practice, with the note that what the diagram gives is the area in square feet × ½½, so that the addition of two readings for two successive sections 100 ft. apart gives the end area volume between them by adding them together. If the length of the solid be less the proper fractional part of the sum must be taken:

21. RULE FOR USE OF DIAGRAMS FOR "THREE LEVEL" CROSS-SECTIONS.—First add together the distances out of the two slope-stakes, to obtain the value of *D* (the horizontal width of section). Then *follow up the vertical line representing the given value of D to its intersection with the* INCLINED *line representing the given center height, or value of c. Hold the point of intersection, and read off the solidity for a half-station from the horizontal lines.*

The sum of the quantities for any two sections is the end area solidity between them for a full station. For fractional or *plus* stations, multiply that sum by the proper decimal part of 100 ft.

Example.—To compute the solid shown in Fig. 8. For the first section, take on Plate III, or on Fig 7, which is an extract from Plate III, the vertical line marked 45—the value of *D* for the first section—and follow it up to the inclined line representing the given center height, 8.4. A heavy line marked 8 is first met with, the next line above is 8.2, and the *next* line is 8.4. Place the needle-point on the intersection of these two lines, and read off the solidity from the horizontal lines.

In this case the point of intersection lies exactly on the line 500, which is the solidity required. Had the center-height been 8.6, the solidity would have been 508; had the center-height been 8.8, the solidity would have been 517; and had it been 9.0, the solidity would have been 525.

To read off the solidity of the second section determine first the vertical line 55.5. This is midway between those marked 55 and 56, and midway between the

fine lines for $D = 55.4$ and 55.6. Follow up this imaginary line to the inclined line $c = 9.8$, and, placing the needle-point on the point of intersection, the solidity is seen to be 712; the fine horizontal line for $s = 710$ being immediately below it. The total volume of the solid is then 500 + 712 = 1,212 cu. yds.

24. SECTIONS CAN BE REDUCED TO AN EQUIVALENT LEVEL CENTER-HEIGHT by means of the Curve of Level Section, as follows: After having determined the point of intersection for the values of D and c in any given case, and the horizontal line on which it lies, follow along that horizontal line till it intersects the Curve of Level Section. The inclined line of c, interpolated if necessary, which passes through this point of intersection, gives the center-height required.

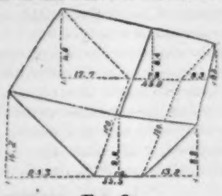


Fig. 8.

The principle of this is obvious. The two sections must necessarily have the same area, since the points of intersection found for them are on the same horizontal line.

Example.—Take the first section of Fig. 8. After determining on Fig. 7, that the point of intersection, as obtained in paragraph 21, lies on the line 500, follow along that line till it cuts the Curve of Level Section. The inclined line passing through the point of intersection is read off as 8.7, which is the equivalent level center-height. In the second section, the equivalent level center-height is read off in the same manner as 11.1.

IRREGULAR THREE-LEVEL CROSS-SECTIONS—i. e., *those having intermediate levels taken*—should be computed as follows: Take off readings for all such sections as if regular, neglecting intermediates; then plot the *surface lines only* of all such sections, and take off for all such sections at once, from the diagram of triangular prisms the correction to be added to or subtracted from the original reading on account of such irregularity.

57. FIVE-LEVEL CROSS SECTIONS—i. e., *those in which two additional surface-levels are regularly taken over each road-bed angle*, as shown in Fig. 16—may evidently be divided into three sets of two triangles each, and computed in a similar way from the Diagram of Triangular Prisms (no extract from which is given here) as follows: Enter the diagram successively, with the center-height and width of road-bed, and with the distance out to each slope-stake and corresponding road bed level. The sum of the three quantities obtained is the solidity.

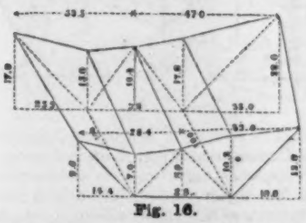


Fig. 16.

Example.—The prismoid shown in Fig. 16. To compute the solidity, entering the diagram of triangular prisms with,

$D = 28.0$, $c = 16.4$, we obtain		425	
$D = 39.5$, $c = 15.0$,	"	549	
$D = 47.0$, $c = 17.8$,	"	775	1,749

For the second section, entering with

$D = 28.0$, $c = 8.0$, we obtain		207	
$D = 28.4$, $c = 7.0$,	"	184	
$D = 32.0$, $c = 10.2$,	"	302	693

Total end-area solidity.....2,442

After determining the above end-area solidities, the true solidity by the prismoidal formula of either solid above may be determined exactly by a correction taken at inspection from the Diagram of Prismodal Correction, or, approximately, by a similar correction taken from a little table in the volume. But whether these subsequent corrections are made or not is a matter of choice.

Irregular Earthwork of every form may be computed from the Diagram of Triangular Prisms, in a similar way to that used in computing Fig. 16, above.

From the preceding it will be clear that quantities can be read off in cubic yards by any intelligent rodman, direct from the notes, after an hour or two's practice or instruction. They do not require any new or special mode of taking field-notes or computing from them, but simply perform automatically all multiplication and division in the ordinary process of computing earthwork from ordinary notes by any ordinary formula, including the method of "end areas," the mathematically exact and two approximate applications of the prismoidal formula, and computation by the formula given in Henck's "Field-Book for Engineers." A discussion of the comparative theoretical merits and value of these various formulæ, which may fairly be said to be the most complete and thorough given in any text-book, is included in the text.

Full directions for constructing diagrams are given if it is desired to have them on a larger scale—to read to tenths of a cubic yard—or for other road-beds than those given. All the ordinary single-track road-beds are given, however, and by a simple constant correction any one of the plates can be used for any road-bed whatever. By their aid the tedious labor of computing earthwork is practically annihilated. There is nothing left to do but to prepare the office record of the field-notes in the ordinary manner, and the quantities complete—requiring only to be corrected for fractional stations and added together—are then easily read off as the field-notes can be called off and the readings recorded. The resident engineer over 5 to 15 miles is thus spared a most tedious labor, and it is fully in the power of a division engineer over 50 to 100 miles to check over his entire earthwork estimates in his intervals of leisure when passing over the line.

To further illustrate the application of the method, and the degree of accuracy attainable by moderate care in practice, we have (1) set down at random a number of succeeding sections of such dimensions as to come within the range of Fig. 7; (2) the readings (areas × $\frac{10}{27}$) taken off from Fig. 7 *at first inspection, and uncorrected;* (3) the correct readings, as computed numerically; (4) and (5) the corresponding volumes:

Station.	Cross-section.	Values of D.	Readings from diag.	Computed do.	Volume c. y. by diag.
1	$\frac{19.5}{+7.0} + 7.0 \frac{25.5}{+11.0}$	45.0	442	441.667	
2	$\frac{22.2}{+8.8} + 9.2 \frac{24.0}{+10.0}$	46.2	550	550.222	992
3	$\frac{24.0}{+10.0} + 11.3 \frac{27.0}{+12.0}$	51.0	717	716.944	1267
4	$\frac{25.8}{+11.2} + 12.0 \frac{25.5}{+11.0}$	51.3	735	735.000	1472
5	$\frac{23.7}{+9.8} + 10.8 \frac{26.1}{+11.4}$	49.8	674	674.667	1439
6	$\frac{21.6}{+8.4} + 8.3 \frac{24.6}{+10.4}$	46.2	511	511.722	1185
7	$\frac{20.4}{+7.6} + 7.8 \frac{27.0}{+12.0}$	47.4	505	505.611	1017
8	$\frac{19.5}{+7.0} + 6.9 \frac{23.7}{+9.8}$	43.2	417	416.000	923
	Totals.....		4572	4571.833	8295

Here the total error in sections involving over 8,000 cu. yds. is less than *one-tenth of one square foot of area* in all, no one of these quantities having been corrected in the slightest from the first reading, nor any left out because they were read in error. The single readings are more out, of course, the worst error being in the last (1.0 cu. yd., or about ⅓ sq. ft. of area) which is probably accounted for by the fact that the engraving is a little out along the edge. Only two other sections (5 and 6) are out more than 0.5, corresponding to ¼ sq. ft. of area.

The above is a perfectly fair sample of the accuracy which can be, and is, habitually attained in practice by any one who is enough of an engineer to understand the accurate reading of a scale, while the saving of time in this most monotonous work is simply enormous, as anyone can see for himself by computing the above sections, first by the diagram and then numerically. To use the diagrams to advantage two men should work together, one reading from the diagrams and the other calling off dimensions (45.0, 7.0; 46.2, 9.2; etc.) and recording the readings. The work is done about as fast as they can talk.

The gain in accuracy is also great because large errors will escape detection in numerical work, and are far more likely to occur than in a mechanical process like this which does not tax the mind. In view of all these facts we cannot but think that the engineer who does not use this method for earthwork computation, and save himself that otherwise tedious labor, lays himself open to the just accusation that he is better provided with pencils than brains.

The Quantity of Distribution Water required for the proper working of a Sewerage System.

Mr. JULES ARNOULD, in the *Revue d'Hygiène*, gives a resume of an interesting memoir of M. C. H. SCHNEIDER, a civil engineer of Fribourg-en-Brisgau, upon the normal conditions controlling the quantity of water required in sewers.

The city of Fribourg en-Brisgau, founded in the twelfth century, formerly utilized the waters of a stream which has since served for the removal of sewerage from certain houses, but which belonged (outside the city) to a society of proprietors and not to the commune. The city itself was, in 1873, supplied by water from a conduit furnishing as a maximum 1900 c. m. per day. This conduit supplied 45 public fountains by 75 openings and also 134 house connections. The suburbs possessed two independent but small conduits of spring-water.

In 1873 it was decided to establish new works. Without entering into details it is sufficient to say that they were finished in 1876 and furnished Fribourg with from 7,500 to 12,000 c. m., according to the season. This water was so pure that the chemists of the place served it out as distilled water. At this time the population was about 31,000, and the daily supply was from 80 to 97 galls. per head. Now the population is 42,000 and the supply is from 45 to 71 galls. per head. This is neither too much nor too little, but the new works have much modified the previous conditions.

In making provisions for the distribution of water, the health of the city as secured by a complete system of sewerage had not been taken into proper consideration. Fribourg grew, and the streams of the old city could not take care of the waters poured into them by the new construction. So in 1876 the regular sewerage of the city was commenced and the work was carried on until 1882, the commune paying one-third and the householders two-thirds of the expense.

The designers of this drainage scheme had started with the false idea that the moment a system of sewerage was in operation for the removal of rainfall and ordinary domestic waste, that they would be able without further expense to turn into this system all fecal matter as well. On the other hand, the city ordinances of 1874 and 1876 provided that the immediate removal of all matter be assured, and practically prohibited the introduction into the streams of foreign matter that was capable of altering its properties.

Nevertheless, in 1884, a report, emanating from the local sanitary committee, concluded that the streams of the city and the distribution system combined would furnish a quantity of water sufficient for the operation of the sewers up to their proper water-line. A little later, a new report recommended that the introduction of water-closets ought to precede the discharge of fecal matter into the sewer, and affirmed that the 7,500 to 12,000 c. m. of water derived from the new works would be sufficient for the service of closets placed in all the houses. But in July following, the municipal authorities officially shut down the supply to strict necessity only, for the months of July and August. In 1885, the same scarcity of water was felt in the summer months, though a commission appointed to investigate the matter again declared that the 45 to 70 galls. per head per day was sufficient to flush out the sewers. But notwithstanding this opinion, the

authorities were compelled, on August 3, to suspend all watering of gardens, courts, streets and pavements. But in July, 1886, by which time 10,000 of the inhabitants were using closets discharging into the sewers, the water-supply again failed to meet the demand.

The author of the memoir shows from the above experience that (1) because a certain quantity of water will flush the sewers of one city, the same supply per head may fail to do its work under other conditions. (2) That 45 to 70 galls. per head, while sufficient for 30,000 people without water-closets but accustomed to the luxury of water and even to its waste, will not suffice for 40,000 inhabitants who have adopted modern conveniences, unless the citizens change their habits and abandon their former prodigal use of water.—*Le Genie Civil.*

The Testing of Portland Cement for The Harbor-Works of Calais and Boulogne.*

BY F. GUILLAIN.

[Nouvelles Annales de la Construction, vol. i i., p. 88.]

In 1884, the French Minister of Public Works established a laboratory for testing Portland cement in Paris, with branches at Boulogne, La Rochelle, and Marseilles. As the result of a number of experiments carried out at this laboratory with more than 12,000 briquettes, a specification for the supply and testing of Portland cement has been drawn up, the details of which are given in this Paper.

To determine the weight of the cement, only the fine powder is used, which has passed through a sieve of 5,000 meshes per square centimetre (32,257 meshes per sq. in,). This powder is filled into a litre measure (1.76077 pint), with certain precautions which are specified. The weight of one litre of the kind of cement delivered, must be within 100 grams (3.5 oz.) of that of a litre of cement of similar fineness ground in the same manner; but derived from specially selected, heavy clinker from the same factory.

With regard to the chemical test, the cement must not contain more than 1 per cent. of sulphuric acid or sulphides in determinable proportion. Cements containing more than 4 per cent. of ferric oxide, or in which the ratio of the silica and alumina combined to the lime is less than 0.44, are to be regarded as doubtful. In mixing the mortar for testing, sea water is specified, and both air and water are to be maintained at a temperature of 15° to 18° Centigrade (59° to 64.4° F.) during the continuance of the experiments. The proportion of water to be used must be the same for all tests made on the same day with one and the same kind of cement, and the whole quantity of water must be added at once to the 900 grams (31.7 oz.) of cement used. The mortar is to be mixed with a trowel for five minutes upon a marble slab. The quantity of water is ascertained by a preliminary experiment, and the four following tests are given to serve as an indication whether the proportion of water added is correct:—

1. The consistence of the mortar should not change if it be gauged for an additional period of three minutes after the initial five minutes.

2. A small quantity of the mortar dropped from the trowel upon the marble slab from a height of about 0.50 metre (1.64 ft.), should leave the trowel clean, and retain its form approximately without cracking.

3. A small quantity of the mortar worked gently in the hands should be easily moulded into a ball, on the surface of which water should appear. When this ball is dropped from a height of 0.50 metre (1.64 ft.), it should retain a rounded shape without cracking.

4. If a slightly smaller quantity of water be used, the mortar should be crumbly and crack when dropped upon the slab. On the other hand, the addition of a further quantity of water—1 or 2 per cent. of the weight of the cement—would soften the mortar, rendering it more adhesive, and preventing it from retaining its form when allowed to fall upon the slab. It is recommended to commence with a rather smaller quantity of water than may be ultimately required, and then to make fresh mixings with a slight additional quantity of water.

In order to determine the time of setting of the cement, a portion of it is made into a mortar and filled into a cylindrical box of metal 0.04 metre (1.575 in. in height, and 0.08 metre (3.15 in.) in diameter. The mortar is then shaken down by a few gentle blows, and the water which rises to the surface is allowed to remain. A needle of 300 grams. (10.58 oz.) weight, and with a square section of 1 square millimetre (0.00155 sq. in.) is suspended over the box by means of a cord and pulley, and the initial set is considered to have taken place when the needle fails to penetrate the whole depth of the mortar if lowered gently upon it. The cement is said to have set finally when its surface will support the needle.

Any cement commencing to set in less than thirty minutes, or setting finally in less than less than 3 hours, is to be rejected, and the final set must have taken place within 12 hours. In each case the time is reckoned from the moment the water is poured upon the cement.

The water-test is carried out by making pats or cakes of cement 0.08 to 0.10 metre (3.15 to 3.94 ins.) in diameter and 0.03 metre (0.787 in.) thick in the middle, and running out as thin as possible at the edges. These are placed upon pieces of glass and immersed in sea-water at a temperature of from 15° to 18° Centigrade (59° to 64.4° F.) These samples must show no cracks or bulging. Eighteen briquettes are used for the tensile test, the cement being mixed with a trowel in quantitities of 900 grams [31.75 oz.] at a time, and worked for five minutes before use.

The form of the briquettes and the machine for testing them are the same as those used in Germany, the breaking section being 5 square centimetres (0.775 sq. in.) The moulds are placed upon a marble slab while being filled, and are allowed to remain upon it until the briquettes are perfectly set, when they are removed from the molds, and, after the lapse of 24 hours from the time of mixing, are immersed in sea-water, which must be kept at a temperature of 15° to 18° Centigrade (59° to 64.4° F.) and which is renewed weekly. Six of the briquettes are broken after an interval of 7 days, six after 28 days, and the remaining six after 84 days. The mean of the three highest figures of each series of tests is taken as the tensile strength of the cement under examination. The minimum strength specified for the neat cement in 7 days is 20 kilograms per square centimetre (284.5 lbs. per sq. in.); in 28 days, 35 kilograms per square centimetre (497.8 lbs.) per sq. in., and at least 45 kilograms per square centimetre (640 lbs per sq. in.) in 84 days. If, however, the strength in 28 days is not more than 5 kilograms per square centimetre (71.12 lbs. per sq. in.) in excess of that at 7 days, then it must be at least 55 kilograms per square centimetre (782.27 lbs. per sq. in.) in 28 days, and in any case where this strength is not attained at 28 days it must be exceeded in 84. Tests of cement mixed with sand are also specified. The standard sand is produced by crushing quartzite obtained from quarries near Cherbourg, and sifting it through sieves of 64 and 144 meshes per square centimetre (413 and 929 meshes per sq. in.). That which remains between these two sieves is washed and dried, and constitutes the standard sand; 375 grams (13.277 oz.) of this sand is mixed with 125 grams (4.409 oz.) of cement, and water is added in the proportion of 12 parts by weight to 100 parts of sand and cement combined. The sand and cement are first carefully mixed in a basin or capsule, then the whole of the sea-water is added at once and the mixture stirred with a spatula for five minutes.

In filling the moulds a small rammer, weighing about 300 grams (7.05 oz.) is used to beat in the mortar until water rises to the surface. The excess of mortar is then struck off with a straight knife-edge and the surface smoothed down. When the mass is sufficiently hard the moulds are removed, but the briquettes are allowed to remain upon the slabs in a moist atmosphere for 24 hours, after which they are immersed in sea-water and treated in the same manner as in the tests with neat cement. At the expiration of the seventh day the strength of the sand-cement briquettes should be at least 8 kilograms per square centimetre (113.78 lbs. per sq. in.), and in 28 days 15 kilograms per square centimetre (213.35 lbs. per sq. in). In 28 days the strength should exceed that at 7 days by 2 kilograms per square centimetre (28.45 lbs. per sq. in). In 84 days the strength must be greater than at 28 days, and at least 18 kilograms per square centimetre (256 lbs. per sq. in). The 84 day tests are only considered indispensable for those cements which may have stood the two previous tests; but if, while the cement is in store, the 84 days tests should be unsatisfactory it may be rejected.

The definition of Portland cement given in this specification strictly excludes so-called puzzuolana cements, or those made of lime mixed with slag. The size of mesh of the sieve is not clearly specified, the thickness of the wire not being stated. The percentage of sulphides in the cement is said to be an indication of adulteration with blast furnace slag, it being supposed that sulphates only are formed during the burning of Portland cement. The degree of fineness to which the cement must be ground is not specified, it being considered that very fine grinding increases the strength chiefly during the duration of the tests, and that the subsequent increase of strength is less with fine than with coarse cement.

* From Abstract of Papers; The Institution of Civil Engineers.

A Contractor's Coat-of-Arms.

The armorial bearings herewith illustrated were granted to a firm of contractors, of Hibernian and Germanic extraction, by the Herald extraordinary to an engineer corps, and we obtained them from his official archives carefully filed away in the off-end of a transit-book. According to his records, which would probably shock Sir BERNARD BURKE, the arms were described as follows:—ARMS—Azure, (defying the rules of heraldry but typical of prospects) saltire-wise 2 pick-axes with a crow-bar pale-ways, in base 2 hammers saltire-wise with a powder-keg, all very proper, on a fesse gu. 3 Dollars (total profits)

nickel plated. CREST—An antique appliance for converting Cabbage into Kraut, with two sprigs of shamrock displayed, also proper. SUPPORTERS—*Dexter*, a Dutchman capped, piped and shod, proper. *Sinister*, a Hibernian, waving an ancient war-club, all eminently proper. MOTTO—"Blast the Rocks!" which freely translated, meant that the rock was pretty tough and hardly allowed the proper margin of profits. An alternative motto appended to the record read "Dam the Water," which would lead us to suppose that there was some trouble on that score also. Some of our readers may recognize the firm referred to as bearing this proud achievement.

THE West End Street Ry. Co., (Boston) has petitioned the Board of R. R. Commissioners for leave to increase its present capital stock of $80,000, by the amount of $1,120,000, making a total of $1,200,000. The hearing was fixed for Aug. 19. The purposes stated are to pay the indebtedness of the company, incurred in the purchase of land on Beacon street, $200,000; for constructing new section of B & A bridge on Beacon street, $25,000; payment of debt for street construction, Brookline, $320,000; for building and equipping the West End Ry. in Brookline (eight mile single track) $240,000; for lands and buildings, $405,000; legal expenses, $10,000. The Boston Consolidated road had voted to come into the West End combination, and the stock is now being exchanged into West End preferred. This company now controls practically the entire transit facilities of Boston. It has, or will have shortly, 200 miles of track, has 7,872 horses and 1,562 cars, and carried 86¼ million passengers last year. Its capital stock is $6,400,000 preferred entitled to 8 per cent, cumulative dividends forever, and (to be) $1,200,000 common stock, total $7,600,000. The funded debt is $3,237,442, making a total of $10,837,442 in securities.

The American Line from Vera Cruz to the City of Mexico, via Jalapa.

WITH NOTES ON THE BEST METHODS OF SURMOUNTING HIGH ELEVATIONS BY RAIL.

[A paper by A. M. WELLINGTON, M. AM. SOC. C. E. read before the American Society of Civil Engineers.]

The line described in this paper, and illustrated in the accompanying maps and profiles, is one located by the writer, as consulting and afterward chief engineer, from the Port of Vera Cruz to the city of Mexico, *via* the city of Jalapa, being a parallel line to the existing Mexican Railway—the first railway built in Mexico—in the sense of connecting the same termini, although following a very different route and of a very different character.

All the features of interest and of difficulty, both in the line here described and in the line of the Mexican Railway, are confined to the mountain grade by which the necessary abrupt ascent from the level of the sea to the level of the plateau, 8,000 ft. above the sea, is accomplished. Once on the plateau there is no great difficulty in going almost anywhere with very light work; many high mountains being scattered around, even on the plateau, but disconnected, with flat lands between.

The elements which appear to make the mountain grade of this line particularly worthy of description are these:

First.—It is believed to be by far the longest continuous grade line ever located; 116.9 kilometers (72.64 miles), having been located on an unbroken 2 per cent. grade (105.6 feet per mile), rising in that distance from elevation 600.4 ft. (183 meters) to elevation 7923.3 ft. above the sea (2415 meters). The accompanying Fig. 1 shows graphically the extent of the contrast in this respect with some of the other great inclines of the world.

Secondly.—It is believed to be on the lowest rate of grade, by about 2 per cent., ever successfully attempted for accomplishing within a limited distance, either by a continuous grade line or otherwise a rise of over one-half as much as was attained on this line. The grounds for this belief also are shown in the accompanying Fig. 1.

Thirdly.—The line is believed to be, by probably one-half at least, the cheapest line per mile which has ever been actually located, with equally favorable alignment, for attaining within a limited distance as much as one-half the rise actually attained by this line, either by continuous or broken grade lines, on any rate of grade. As for this, Table 1, the topographical map on the inset sheet herewith, the profile of the same line which will appear next week, and the general knowledge of engineers is the only evidence that can conveniently be appealed to, or which it is worth while to attempt to present.

Finally.—It appeared that the manner in which the line was obtained might have a certain instruction and encouragement to those who may be dismayed, as was the writer, by having similar problems of unusual difficulty suddenly thrust upon them, and it was also desired to give, in connection with the description of the line, certain conclusions which the observation and experience of the writer has indicated—not only on this incline, but on eight or ten others of considerable rise, which have been located or relocated in part or whole under his supervision, aggregating over 24,000 vertical feet—in regard to the most advantageous and economical manner of dealing with great inclines, under which may be classed anything exceeding 1,200 to 1,500 ft. of vertical rise.

It is one of the unfortunate features of the department of engineering to which this paper refers—that of laying out railway lines to the best economic advantage—that a mere description of a located line has ordinarily little technical interest or instruction, since it is ordinarily impossible to so carefully describe any line on paper as to enable even an intelligent impression to be formed as to the real character of the work. If the grades and work be light, it may be because the line was well laid out, or it may be simply because there were no serious natural obstacle in the way. On the other hand, if the grades and work be heavy, it may be due to bad engineering, and so discreditable; or it may be due to the existence of gigantic difficulties, and so an evidence of skill. It is but natural, however that the magnitude of the natural difficulties to be overcome should in general be regarded of bearing some nearly constant ratio to the magnitude of the works constructed to overcome them; and hence, that, even when the construction of a very costly line may have been, as a matter of fact, an avoidable extravagance, due to lack of skill or foresight, the very magnitude of the works gives more instead of less reputation to the line as an engineering work.

Only in the comparatively rare cases when two independent alternate lines exist between the same termini, is it possible for the engineer to find in printed descriptions of located lines, however, perfectly mapped, any rational basis for intelligent judgment. The present happens to be one of the cases in which this is possible, owing to the existence of the parallel line before mentioned, but in order to avail of it, it becomes necessary to enter somewhat into what would otherwise be an invidious—because unnecessary—comparison with the parallel and previously constructed line. The writer feels the less embarrassed in doing this, as, owing to the checkered history of the line, no one engineer can be held responsible for its character, and there were certain circumstances tending to impede entire freedom of choice and proper investigation.

The whole interior of Mexico is a vast plateau, at an elevation of 5,000 to 9,000 ft. above the sea, bounded by an abrupt escarpment from which the descent to sea level is almost immediate. The edge of the plateau is higher and sharper on the Atlantic than on the Pacific Coast, and on no point on either the Atlantic or Gulf Coast is it higher or sharper than directly in line between the capital of the country, Mexico, and its chief port, Vera Cruz. Here two stupendous natural obstacles, the Pico of Orizaba on the south (17,873 ft. high), and the Cofre, or "Box," of Perote (12,500 ft. high), both of them described in physical geographies as volcanoes, although both are temporarily extinct, and the two connected by a ridge over 10,000 ft. high at its lowest saddle—combine to forbid a direct line inward.

Orizaba is one of the three mountains in Mexico covered with perpetual snow, the other two being Popocatepetl (17,884 ft.), and Ixtaccihautl (15,705 ft. overlooking the valley of Mexico. These, however, start from a plain 8,000 ft. high, whereas Orizaba starts practically from sea level on the coast side, making it in that sense by much the highest mountain on the North American Continent,* and among the highest in the world. Its snow-clad peak is visible 60 miles out at sea, long before there is any other evidence of land, and with the morning sun shining on it is a very striking sight. Its last violent eruption was in 1546, soon after the Spanish conquest, although it now occasionally throws out smoke. Only one or two men have ever ascended to its crater, the first one having been Lieut. REYNOLDS, U. S. A., in 1848. The line of the Mexican Railway passes to the south of this mountain as shown on the large inset map.

The Cofre, or "Box," of Perote (so named from a cylindrical basaltic needle about 300 ft. in diameter and 300 ft. high which caps the mountain, like a box laid on its peak), although formerly one of the most active volcanoes in the world, and classed as still active, is perhaps permanently extinct, its last, and probably also its greatest, eruption having been to form what looks to be, and is in fact, a frozen river of lava, shown on the lower inset map, extending to and running into the sea 50 miles distant, filling up an enormous barranca or deep gulch in the process, in a manner which was very convenient for subsequently carrying the line over it, as may be seen on the map. The natural variations in the width of this gulch have caused lakes and frozen "water-falls" of lava, which makes it difficult to believe, as one looks up the slope upon it from some commanding point, that the mass is not still flowing, making it a unique and impressive bit of natural scenery. Vessels have been frequently wrecked in the tow of this flow where it enters the sea. It has still hardly any deposit of sand, soil or vegetation on it, that and other facts evidencing that the flow is geologically very recent, not antedating much the historic era.

Around the north side of this mountain, and directly over this lava flow, the line here described passes, as shown on the map, being about 60 miles north of the Mexican Railway line at its greatest divergence, the two beginning to come together again very soon thereafter. The summit of Perote is just below the limit of vegetation and of perpetua snow, and it is very easily ascended on horseback to the foot of the "cofre," or box, that fact alone being an evidence to the engineer of how different the topography of its slopes must be from those of its southerly companion. Evidences abound of tre mendous flows of lava in remote geologic times, which are now covered to a considerable depth with soil, and in the kind of pocket formed between the foot-hills of the two great mountains, in which lie Jalapa and Contepec, the detritus of ages has accumulated, including probably great amounts of volcanic ash, so that no rock exists over large areas, as was afterwards discovered, except in isolated points.

CORTEZ followed this route on his first invasion, as did General SCOTT 328 years later, but from an early date after the conquest of CORTEZ, two leading routes have existed between the interior and Vera Cruz, following substantially the two railway lines here described, one through Jalapa, rounding Perote to the north, and the other *via* Orizaba, rounding the mountain of that name to the south. The northerly line was first constructed, and over it, for 300 years (between 1521 and 1812–20) passed vast sums of silver and gold, practically the entire product of the Mexican mines, amounting in the aggregate to $3,000,000,000, or nearly half of the value of silver in the whole world, which, in 1876, was estimated at $7,232,071,674, exclusive of what existed before 1520, which was relatively little. During all this time the southerly route was an insignificant trail, but early in this century the southerly route took prominence, and the Jalapa *camino real*, or "King's highway" (as the leading roads are still called in republican Mexico), was suffered to fall into decay. It had originally been paved guttered and curbed for the entire distance from Jalapa to Vera Cruz, some 73 miles, and from Jalapa up the mountain a fine macadamized road, likewise curbed and guttered, existed, and still exists in fine order, having been recently repaired.*

Within 15 or 20 years after the abandonment of the northerly highway, as early as 1837, the movement for a railway between Vera Cruz and Mexico was begun by Don FRANCISCO ARRILLAGA, and very naturally, but very unfortunately, the route which had by that time become the only one generally known, assumed a prominence which it held to the end. The very facts which made it best suited for a highway, that a very comfortable valley ran directly up into the bowels of the mountains, from which the ascent was abrupt and sharp to the plains above, made it unsuited for a railway line, but this could hardly be appreciated at that early day.

By 1854, the construction of a tramway from Vera Cruz had been begun, Don ANTONI ESCANDON, a wealthy Mexican banker, who was chiefly instrumental in pushing the project through to completion, having then taken hold of the enterprise. Don ANTONIO had a large estate near Orizaba, and his property interests may well have somewhat influenced the final decision. However this may be, in 1857, Colonel ANDREW H. TALCOTT, an American engineer, arrived with a staff of assistants, the only member of which now living, the writer believes, is Mr. S. WIMMER, M. Am. Soc. C. E., then a very young man, after whom one of the leading bridges of the line was subsequently named. According to one of the published histories of the road, all these engineers confined their labors to the Orizaba line, that *via* Jalapa being entrusted to a Mexican engineer Don PASCUAL ALMAZON. According to other accounts, a commission of engineers examined both lines. If the first was the case, it is less surprising that "on comparing the separate surveys," as the history of the road states, that by Orizaba was finally adopted, on the grounds, first, that there was more traffic to be secured on it (which is rather more than doubtful, although the local traffic at best is an insignificant element), and secondly, that "notwithstanding it requires great and costly works, the line presents greater facilities than that by Jalapa, *where the larger number of ravines and the harder nature*

* Mount St. Elias, in Alaska, is a possible exception, being only about 20 miles inland, and its height variously given as 14,970 16,940, 17,850, "over 18,000" (U. S. Census Report) and 19,500.

* On the lower part of this highway a splendid stone bridge, the Puente Real, or as now described, the Puente Nacional, which has been not unreasonably claimed to be "worthy of the best days of Rome," still exists in perfect order, and as showing the fine quality of the Mexican lime, the joints are considerably harder than the stone itself (which is durable but rather soft) and are worn less.

of the soil would have required much heavier outlay." A greater mistake than is contained in the italicized part of the quotation could not well be.

Colonel TALCOTT'S estimate of the line was $15,000,000, but nothing more was done than to build about 10 miles of surface line out of Vera Cruz, until August, 1864, when the military necessities of the Emperor MAXIMILIAN led to a real beginning and prompt pushing of the work under English engineers, and by an English company, which still controls it. Beyond a statement that the resumption was "after rectifying the plans of Colonel TALCOTT," the official history contains no record of the second examination of the whole question of route, which was in fact made, although how thoroughly the writer cannot state.

By 1867 the line was opened from Vera Cruz to Paso del Macho, 47½ miles, and from Mexico to Apizaco, 86¼ miles, the rails for the latter being hauled by wagons an average of 200 miles inland, at enormous cost, a hard condition imposed by the Mexican Government. A third change of engineers took place about this time, while the heavier parts of the work was still unexecuted. In 1868, the Puebla branch, 29 miles, was opened, the rails for it having been hauled in the same manner. In 1870 the line was opened to Atoyac, 54 miles from Vera Cruz; in 1871 to Fortin; in 1872 to Orizaba, and on the last day of that year the entire line was opened with great ceremony.

Shortly thereafter, in 1884, Don RAMON ZANGRONEZ, of Vera Cruz, succeeded in getting a branch line to Jalapa well under way, and in having it assumed by the Mexican Railway, which completed it, as shown on the map, in May, 1875. It is operated solely by animal power, being probably by far the longest horse railway in the world. Its grades are very severe (10 per cent.), and its curves of ordinary horse-car radii. It is laid for a great part of its length along the old *camino real*, and exhibits the same trait as the main line of the Mexican Railway to the foot of the mountains, that is it runs obliquely across the drainage lines, thus materially increasing the difficulties of both lines, but making the Jalapa line absolutely impracticable for an ordinary railway, even with gigantic work. It was probably some such erroneous treatment of the lower part of the descent which led to the condemnation of the route, as it seems impossible that an ascent from Jalapa on a 4 per cent. grade could have been deemed as serious as that from Orizaba on the adopted line.

The main line thus constructed is still one of the most massive and costly in the world. Its cost was abnormally increased by two causes: First, the political condition of the country, which was so much disturbed that it no doubt added much to the cost; and secondly, the absurd requirement that construction, including track-laying, should begin from both ends at once, necessitating the enormous expense referred to for hauling rails over execrable roads from Vera Cruz to Mexico and Puebla. In all some 15,000 tons of rails were thus hauled, at a cost, the writer believes, of some $80 per ton, amounting to some $1,200,000 in all. On the other hand, there was little direct inflation of the capital account, most of the share capital representing actual money paid in. The gross nominal cost of the line was as nearly as may be, $40,000,000, Reducing this by one-half, we shall make an ample allowance for the effect of all abnormal causes tending to increase cost of line, and for the cost of the Jalapa horse railway and the small amount of rolling stock (65 engines, 8 0 cars), leaving $20,000,000 to represent the actual cost of 264 miles of main line and 29 miles of branch. Of this the section between Paso del Macho and Boca del Monte alone, some 60 miles, is in any sense difficult or costly work. The remaining 223 miles is light work, with 1½ per cent. grades, which latter are quite unnecessarily high.

On this basis we may distribute the actual cost (taken at half the nominal) about as follows:

223 miles light work, at $40,000 per mile	$ 8,920,000
60 miles very heavy work, at $184,667 per mile	11,080,000
283 miles in all, at $70,670 per mile	$20,000,000

Both the grades and curves on this line are very severe. Only 10 miles out of Vera Cruz 1.5 per cent. grades begin, which shortly thereafter are increased to 2 per cent., 2.5, 3, and at last to 4 per cent., which latter is entirely unbroken for the last 13 miles of rise, and used also at several other points on the ascent. Curves as sharp as 325 to 350 ft. radius (16° 30' and 17° 40') are used, and six or eight reversed curves of these radii often succeeding each other without any tangent between them, and without any grade compensation, making the virtual gradient fully 6 per cent. Fairlie engines are used to operate this grade between the summit at Boca del Monte (107 miles from Vera Cruz) and Cordova. The remaining 157 miles to the City of Mexico, as well as the lower and easier part of the mountain grade (which, however, has 2½ to 3 per cent. grades, increased by unreduced curvature), is operated by American engines. Very naturally both the freight rates and the expenses are fabulously high, receipts ranging from 10 to 12 cents per ton mile, and as high as $8 per train mile; expenses being from 50 to 60 per cent. of receipts. To show how radically the cost and revenue from the operation of this line differs from anything with which we are familiar, it was calculated that in 1883 that with the Mexican rates the New York Central would earn $27.25 and the Erie $28.50 per freight train mile, and their total freight earnings would have been in one year $297,025,000 and $244,300,000 respectively—$168,000,000 more than the Central's whole capital account, and $93,000,000 more than the Erie's.*

There are fourteen tunnels in all on the line, none of them, however, very long, and about as many viaducts. The grading is, for miles together, almost wholly rock, and the work, as a whole, can only be described as Titanic, so that it is small matter of surprise that almost every one who writes about the line describes it in much the same terms as does Mr. GEO. WM. CURTIS, in a late number of *Harper's Magazine* (February, 1886), who chances to be the last writer whose remarks in respect to it have come to the writer's knowledge.

"If it is magnificent scenery that you seek, here at hand, with no intervening ocean, is the railway from Vera Cruz, 260 miles, to the City of Mexico—a marvelous feat of scientific skill, crossing the mountains at a height of 8,500 ft., and bearing you through every climate, amid unimaginable luxuriance and brilliancy of vegetation, changing into temperate hues of hardier growths, with awful mountain abysses between and snow-clad peaks beyond against the deep blue sky."

The line located by the writer rises to almost precisely the same height of summit as the Mexican Railway, and is as nearly as may be of the same length, but in almost every other detail stands in broad contrast with it, thus:

GRADE.—Continuous 2 per cent. (uncompensated) against a broken 4 per cent. (uncompensated); including the effect of curvature or of compensation therefor, 2.6 per cent. against 6 per cent.

CURVES.—Curves of 289 ft. radius (19° 50') connected by minimum tangents of 40 meters (131 ft.), against 16° 30' to 17° 40' curves (325 to 350 ft. radius) connected by no tangents at all for many successive reversions. The writer considers that the difficulty and expense of maintaining these two limits is about equal, but that the latter is decidedly the most objectionable.

AMOUNT OF CURVATURE.—On Mexican Railway 143 curves on the last 20.14 kilometers of the ascent, against 82 curves on the upper 19 kilometers of the Jalapa line, shown on the topographical map and profile which will appear next week. The lower portions of the line will be seen on the map to have much more favorable alignment.

The number of curves indicates, what is the fact, that there is hardly any tangent on the upper portion of the Mexican Railway grade, whereas on the upper third of the line, shown on the topographical map and profile, 41½ per cent. of the line is tangent (the average tangent being 96.3 meters or 320 ft.), and on the whole 54 kilometers which have been engraved, 48 per cent. of the line is tangent. The comparative degrees of curvature cannot be given.

DISTANCE.—The distance between Vera Cruz and San Marcos, where the two lines as actually surveyed connect, was just 20 kilometers (12½ miles) longer via the Jalapa Line, viz., 263 against 243 kilometers. Had the purpose in view been the same, however, merely to get to Mexico, this difference might have been more than eliminated, as will be clear from the dotted line above San Marcos on the larger map.

GAUGE.—The Jalapa line was intended to be laid to 3-ft. gauge, corresponding to the gauge of the Mexican National Railway, whereas the Mexican Railway was 4 ft. 8½ in. gauge. No difference was made in the location, however, on account of the gauge, the road-beds having been taken as 14 and 18 ft., slopes 1 to 1 in cuts and 1½ to 1 in fills, and rails estimated at 56 lbs. The ties were estimated at $1 each, only 7 ft. long, which was the only item estimated in any way lower because of the gauge.

COST.—In Table No. 1 is given an abstract of the large estimate blank prepared from the careful paper location of the entire mountain grade. [Table 1 is omitted to save space, except for the abstract given below.—ED.] Table No. 2 is an abstract closing a report by the topographer, giving in detail the material on the line, from which, in connection with the profile yet to appear, its very favorable character will be seen. From these and the maps and profiles submitted, which even in the reduced engravings show the estimated quantities at each point, any engineer can form his own judgment as to whether the estimate in Table No. 1 is adequate. The writer's belief was, and still is, that it is entirely adequate, and if so the cost of the entire mountain grade, with 30 per cent. added for engineering and contingencies, amounts to less than $40,000 per mile, against $184,677 per mile for the actual cost of the mountain grade of the Mexican Railway, or in the ratio of 1 to 4½. A ratio of 3 to 1 is believed to be the very lowest which could be claimed to correctly represent the relative work. Unfortunately the writer was never able to obtain exact figures of the quantities on the Mexican Railway. Therefore he is reluctant to claim more than is certainly just.*

SUMMARY OF TABLE 2.

	Sections of 100 Meters.
Loam, clay, sand, gravel, etc.	274
Basalt overlaid with 3 meters of earth	26
Basalt, level, etc., overlaid with 2 meters of earth	77
Ancient lava overlaid with 1 meter of earth	149
Soft sandstone overlaid with 1 meter of earth	25
Exposed rock, lava	10
Limestone	21
Total (extending 32 stations below limits of engraved profile	582

[We omit the full Table 2, as its nature is sufficiently given in the summary.—ED.]

Make what allowances one will, there is a great contrast in these two lines, and it therefore becomes of interest to consider how this latter line was obtained.

[TO BE CONTINUED.]

* "Railroad Gazette," June 2, 1883.

* The general route of both lines here described is shown on the larger map. On the smaller one is given a reduction to one-fifth scale, or $\frac{1}{126720}$ (1¼ ins. per mile, within 1 per cent.) of the large topographical map on a scale of $\frac{1}{25344}$ of the upper 54 of the 117 kilometers of the mountain grade. This in turn was reduced from the original field sheets on the large scale of $\frac{1}{1056}$ or 8¼ ft. per in., which the difficult character of the work made necessary. The topography was very accurately taken by a skilled topographer, Mr. MAX CHAPMAN, M. Am. Inst. M. E.

Next week will be given a photographic reduction of the original profile, which was called off, station by station, in the usual way, from a paper location on the original field sheets, and estimated, station by station, from tables, with allowance for surface slope, which often more than doubled the level section quantities. The estimated quantities for each cut and fill are given on the profile and nature of material indicated. Retaining walls were estimated for at every point where a fill would not catch, and are indicated by a thick line on the profile. The small amount of masonry is due to the almost entire absence of surface drainage and running water, as elsewhere noted.

The line, profile and estimate here shown were not finalities, but prepared for a special purpose. Compensation for curvature had not yet been introduced. It was fully expected to do still better at points, and in fact the location shown was greatly improved in the upper section (6) by a new line, run just before the suspension of work which threw the line back from the rugged cliff-work near the summit. As maps and profiles of this improvement cannot be given, no claim in respect to it is made, but only for what had been actually secured and recorded in black and white.

ABSTRACT OF TABLE NO. 1.

Average for 54.5 kilos.	$13,414	55.5 kilos. ave.	$5 694	$9,519
Track and ballast per kilo.	6,773		6,773	6,773
Total per kilo.	$20,187		$12,467	$16,292
Total per mile.	32,483		20,063	26,220

Total for mountain grade complete, 110 kilo. (68.35 miles.) $1,792,100 = $26,220 per mile.

Not including engineers, contingencies, shops, sidings, telegraph, etc., 10 per cent. was allowed for engineering, 20 per cent. for contingencies, and $2,4,000 between Vera Cruz and Puebla for the other items, the whole increasing the above sums by about 35 per cent., or to an average of $35,321 per mile, excluding rolling stock.

NOTES AS TO MATERIAL.—EARTH.—The material is invariably good, dry earth almost wholly free from stone.

LOOSE ROCK.—None occurs, except in Section 5. Much of the lava on the upper sections is really loose rock, but is classed as solid.

SOLID ROCK.—After passing below Section 5, the material is all earth except a small amount of loose rock. On Sections 5 and 9, the material classed as rock is mostly porous lava, which is largely loose in pieces of 1 cubic meter or less.

TUNNELS.—The upper tunnel (100 meters) is in hard white rock the lower (70 meters) is in a soft chalk-like volcanic material. The price of $90 per lineal meter is ample.

MASONRY.—The amount of masonry is very small, from the fact that no considerable drainage is encountered on the lower section, the line being chiefly a ridge line, and on the upper section the soil is so porous that no considerable water flows on the surface, as is shown by the culverts in the camino real, mostly just above the line. Good stone and lime exist on the spot in Sections 5, 8 and 9, where most of the masonry is. For the remainder the haul will in general not be long.

VIADUCTS.—Seven in all were required, aggregating 785 meters, the price being estimated for each separately. Only two short bridge spans (9 meters—30 ft. each) are required on the whole mountain grade, apart from the viaducts hardly any running water being crossed.

TRACKS.—The best material for ballast was readily accessible. Rails weighing 56 lbs. per yd. were allowed for, at $60 per ton. Mesquite ties, 7 ft. by 6 ins. by 8 ins. at $1 each. Joints, $1.25. Ballast, 1,610 cubic meters per mile, at $1. Laying track, $644 per mile.

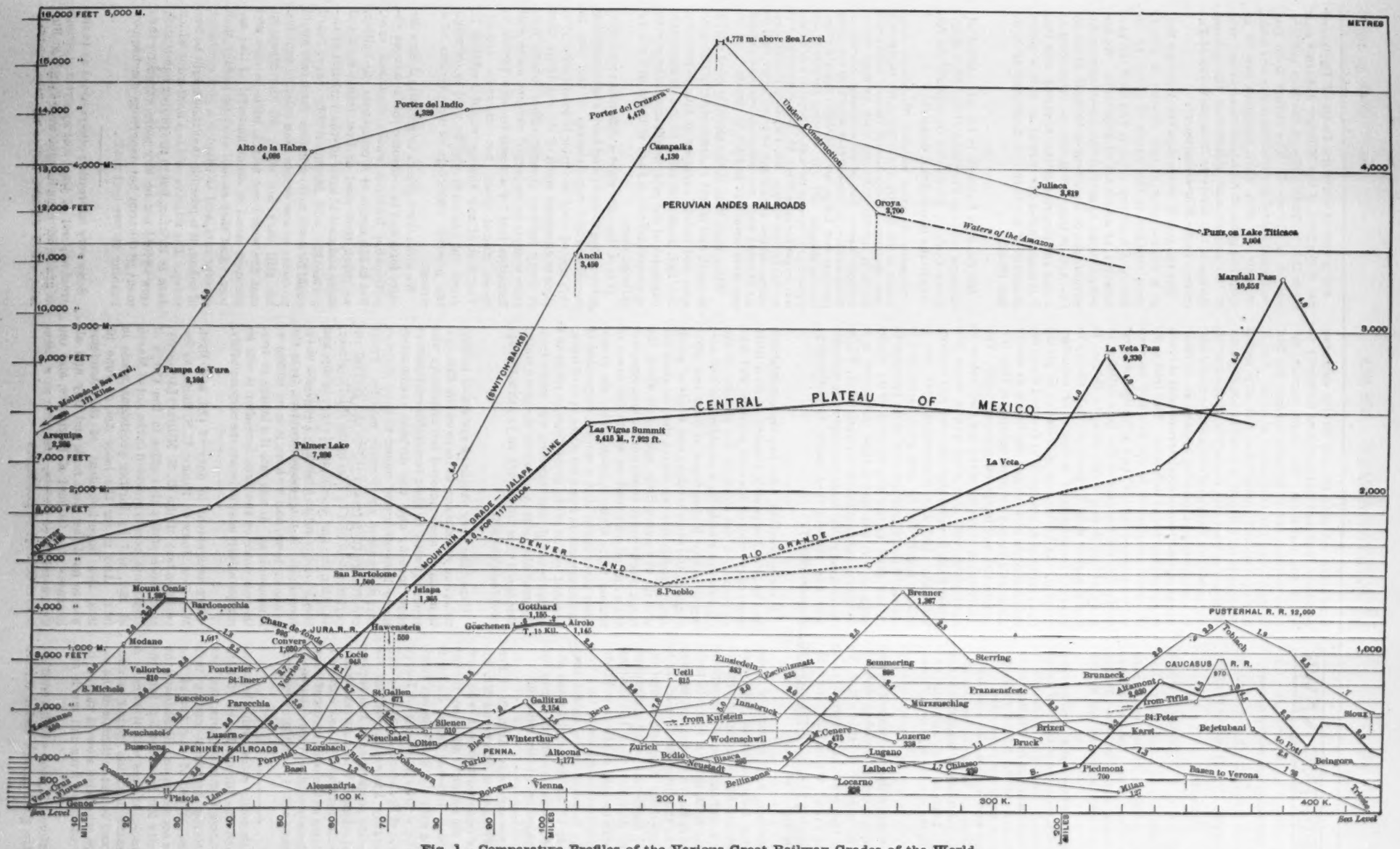


Fig. 1.—Comparative Profiles of the Various Great Railway Grades of the World.

NOTE.—Only the lines shown in comparatively heavy lines on this plate, viz.: The Jalapa line from Vera Cruz, the Denver & Rio Grande, the Pennsylvania, and the Baltimore & Ohio are of the writer's compiling. The remainder has been reproduced from a plate prepared by Mr. W. W. EVANS, M. Am. Soc. C. E., to show the Peruvian lines, and he in turn was indebted to European authorities for the admirable presentation of European railways. Comparative distances are of course to be estimated by the horizontal distance, since the exaggerated vertical scale exaggerates the slant length greatly. A small profile of the Mexican railway is shown on the map of an inset sheet herewith. It could not conveniently be added to this plate for comparison with the Jalapa line. Its general nature will be indicated by projecting a 4 per cent. grade (parallel with the Peruvian line) from Las Vigas summit to the level of Jalapa, and then continuing down to sea level with mixed 1½ to 4 per cent. grades, with some lost elevation.

ENGINEERING NEWS

VOL. XVIII. Saturday, September 3, 1887.

D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.
GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year*, or 3 *cents per number additional*.

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

To avoid any further disappointment among expectant engineers, and to check a flood of applications still coming to this office, we would say that the position, referred to in our issue of July 30 and asking for "an engineer competent to locate and construct a short road in New England," is filled.

OUR correspondents, and especially those sending in matter for publication, will earn the lasting gratitude of our compositors and proof-reader by being more careful in writing personal names. Nothing in a letter is more difficult to guess at than a name, and nothing is so provoking to the interested reader as to find a name misspelled. As a rule we find the clerkly, free and handsome looking signature more difficult to decipher than the crabbed and scrawling sign manual of the more illiterate man. It should be remembered that to a printer legibility is much more useful than "style," so "print" all personal names and names of out-of-the-way localities if you can not otherwise make them plain enough.

The death on the same day (Aug. 19) of Professor SPENCER FULLERTON BAIRD and Mr. ALVAN CLARK, has removed two men who have done very much for scientific advance, though they worked in very different fields. In his 37 years connection with the Smithsonian Institution and as the worthy successor of JOSEPH HENRY, the name of Professor BAIRD was well and most favorably known throughout the world for his active researches in the various fields of natural science. While ALVAN CLARK, himself a practical astronomer, has earned a most enviable fame as the constructor of telescopes of marvelous precision, with which other investigators have added to our knowledge of the heavens.

THE late Chatsworth catastrophe has evidently awakened the Illinois Board of Railroad and Warehouse Commissioners, and they are now scattering broadcast among railroad companies, copies of the Act of last June relative to accidents on railroads and the absolute necessity for investigation into the condition of track, bridges and trestles. A little of this same medicine earlier administered, and forced down the throats of the patients who were otherwise slow in taking it, might have saved many lives and much suffering.

As we have before said, good wooden trestles, for example, are good enough under certain conditions, but they require careful watching and some high and unquestioned authority to watch the watchers. The same remark applies to track and to all good bridges, for bad bridges should be eliminated at once. And if a State railroad commission has any useful purpose in its being, it is to act in the capacity of this guardian over the safety of the traveling public by requiring from all corporations the constant and careful inspection of their works and the immediate improvement of track or structures found defective. The first duty of such a commission is not to stand between an "oppressed public" and a "grinding monopoly," as the framers of the laws existing in some of our States would seem to think. It has a higher duty to perform than simply to hear the complaints of farmer *A*, or manufacturer *B*. And if the law is defective in giving the commission authority to demand these detailed reports and compel obedience to wisely made and proper recommendations, that law is defective and badly needs repair itself. The distribution of copies of the law and letters of instruction will not avail unless there is a power back of them that can and will enforce this law. And the corporation that has a proper regard for its own good name, and is managed in the true interest of its passengers rather than in the sole interest of its stockholders, will welcome a rigid inspection as a further recommendation to public favor. While the company that fears this supervision doubtless has reasons that make its enforcement very necessary.

A correspondent who has been stimulated by the late Chatsworth disaster to do a little quiet inspecting on his own account, and who so inspected the track in the vicinity of the Chatsworth trestle for a considerable distance, writes us that he has found at least two other roads in the same section, and roads of much more prominence (we regret that he does not permit us to give their names) on which the track was in worse condition for long stretches than the unlucky road on which the tower of Siloam fell. While it came under his immediate observation that a special inspection of the structures on some 300 miles or so of track, ordered by one of the great Chicago roads as a consequence of that disaster, was made from the rear platform of an accommodation train! Our space does not permit us to draw the appropriate morals.

UNDER the very excellent system of inspections and reports now in force on the Erie system, there are employed ten inspectors who report directly to their respective roadmasters each month, and the division roadmasters make inspection and report to their division superintendents every three months. These reports are then forwarded to the general superintendent and by him to the chief engineer, showing the true condition of every bridge and trestle on the entire system. The chain of responsibility is thus made complete, from the engineer down, and we hope it is as strong as it is complete. At any rate if a bridge or trestle goes down on the Erie, hereafter it will be comparatively easy to locate the responsibility.

THE assignment to duty of Col. and Brvt. Maj. Gen. JOHN G. PARKE, U. S. Engs., as Superintendent of the U. S. Military Academy, once more places this office in the Corps of Engineers, as was provided in the Act of March 16, 1802, and by further provisions made in 1812. And under the later Act of June 12, 1858, the Superintendent of the Academy was to have the local rank and pay and allowances of a Colonel of Engineers, and the Commandant of Cadets, the same as a Lieutenant Colonel of Engineers

For about 64 years the Corps of Engineers was at the head of the Military Academy and made this institution one of the best military schools in the world. The change from this long established government policy was made on July 13, 1866, when Congress saw fit to open the office of Superintendent to any arm of the service and transferred the general charge of the Academy from the Corps of Engineers to the War Department.

For the last 21 years then the Academy has, as a consequence of this change in policy, been steadily in the hands of either an infantry or a cavalry colonel, who drew the pay, however, of a Colonel of Engineers. We are not prepared to discuss the advantages or disadvantages of the changes brought about by the Act of 1866, but it will be interesting to watch the progress of the Academy now that it is again under the care of so able a representative of the Corps of Engineers as is its late Chief.

MR. CHARLES LATIMER, in his late annual address as retiring President of the Civil Engineers Club of Cleveland, O., referred as follows to the late railway disasters:

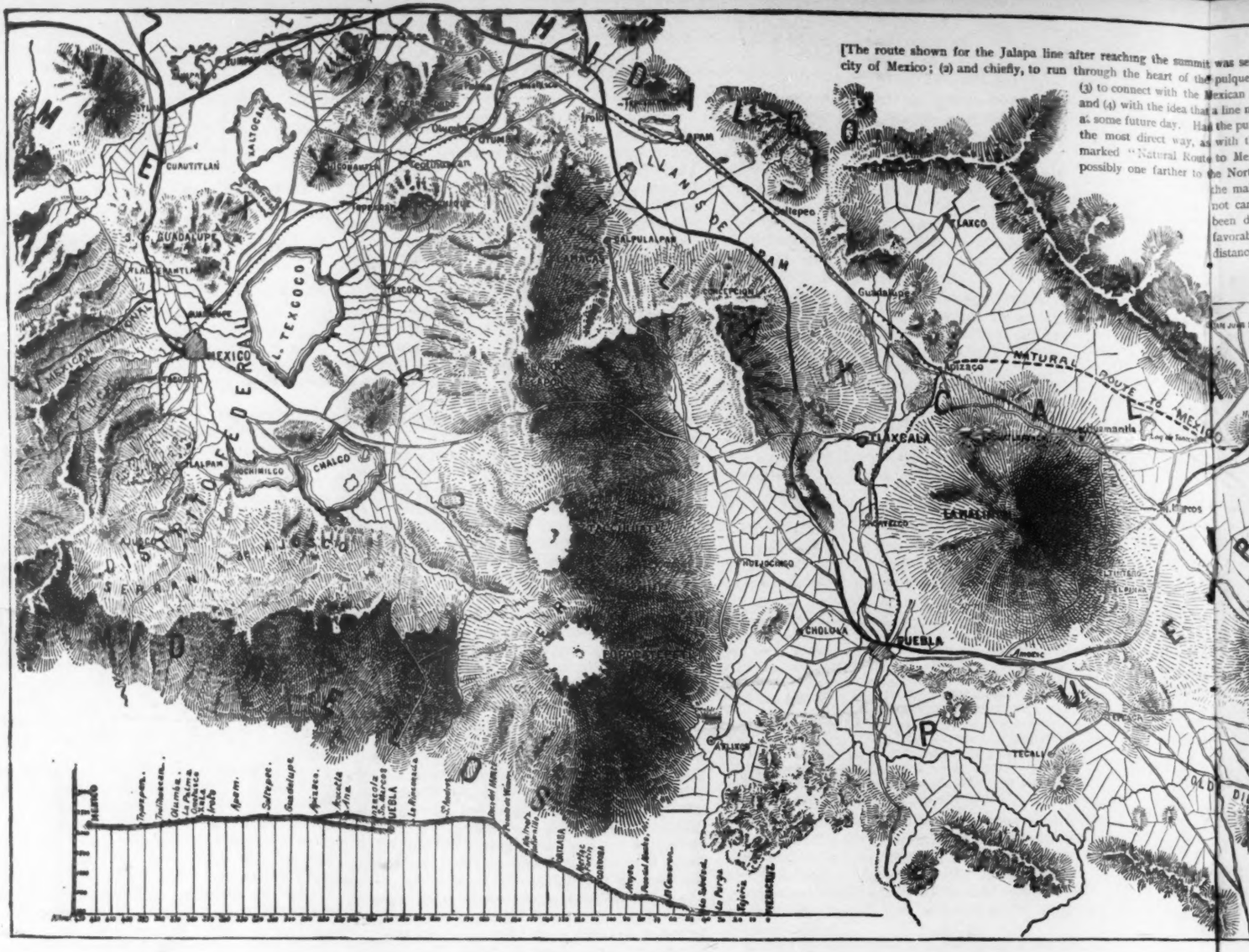
"Disasters are great teachers. Two fearful holocausts in this country, one at Rio on the Baltimore & Ohio, the other at White River in Vermont, and a wreck yet more terrible at Boston, teach us many things. Amongst others: Let us not encourage our men to drink whiskey, by keeping open saloons at the eating stations. 2nd. Let us not use tinder boxes for cars, that is sleeping and day coaches, varnished and painted so to burn as quick as celluloid or gun cotton. 3rd. Do not use open fires. 4th. Do not use explosives for fuel or light on cars. 5th. Put safety guards or re-railing devices at each side of every bridge. 6th. Do not overwork men. 7th. Rest men, beast and material one day in seven. 8th. Be sober, be vigilant."

While each item in the above is good advice in itself, and is very characteristic of this good man and expert engineer of long experience, the 2nd. item, referring to the inflammable character of our cars, would seem to be worthy of greater attention than is being given it by railroad men.

It is at the very start a different problem to solve owing to many and somewhat conflicting conditions and requirements of use. But in this age of steel and iron it would seem possible to eliminate much of the woodwork that in every railway disaster either inflicts horrible wounds by its jagged ends, or worse still furnishes fuel for a death by slow torture to those pinned down, but otherwise unhurt. The cost of any change would doubtless be great, but can such cost be held to outweigh the possible sufferings of the victims of a wreck?

We must leave others to actually design the safer form and to overcome the numerous objectionable features which doubtless exist. But in the hands of a competent car-builder, we think that steel or iron frame-work and sides and roof of some of the varieties of impermeable and incombustible paper-board could be made to do wonders. Such cars would probably be less ornate than existing vehicles, but still they can carry all the ornament that fire would not attack, such as cast and stamped metal or other material of like nature. And they should even be lighter than present cars, and as paper is a poor conductor of sound, it is possible that they might be less noisy. The relative cost is a matter for which data is lacking, but in the proper hands such cars should not be any more expensive than many of the trim but dangerous coaches now running on our best roads.

SOME very interesting observations as to the great amount of time lost by street crossings at grade, were made some weeks since at Buffalo, which deserve notice as only a fair ex-



[The route shown for the Jalapa line after reaching the summit was se
city of Mexico; (2) and chiefly, to run through the heart of the pulque
(3) to connect with the Mexican
and (4) with the idea that a line
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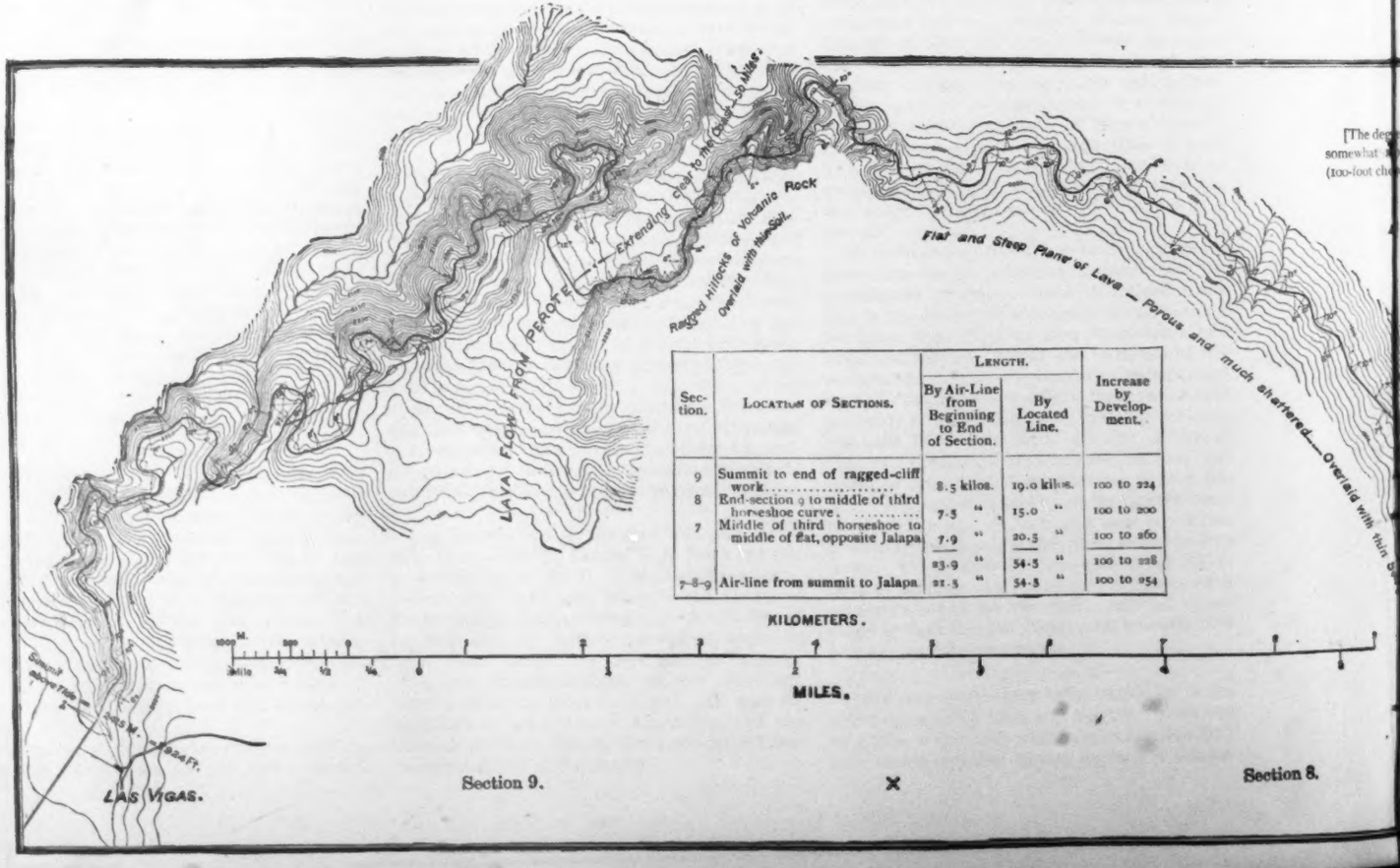
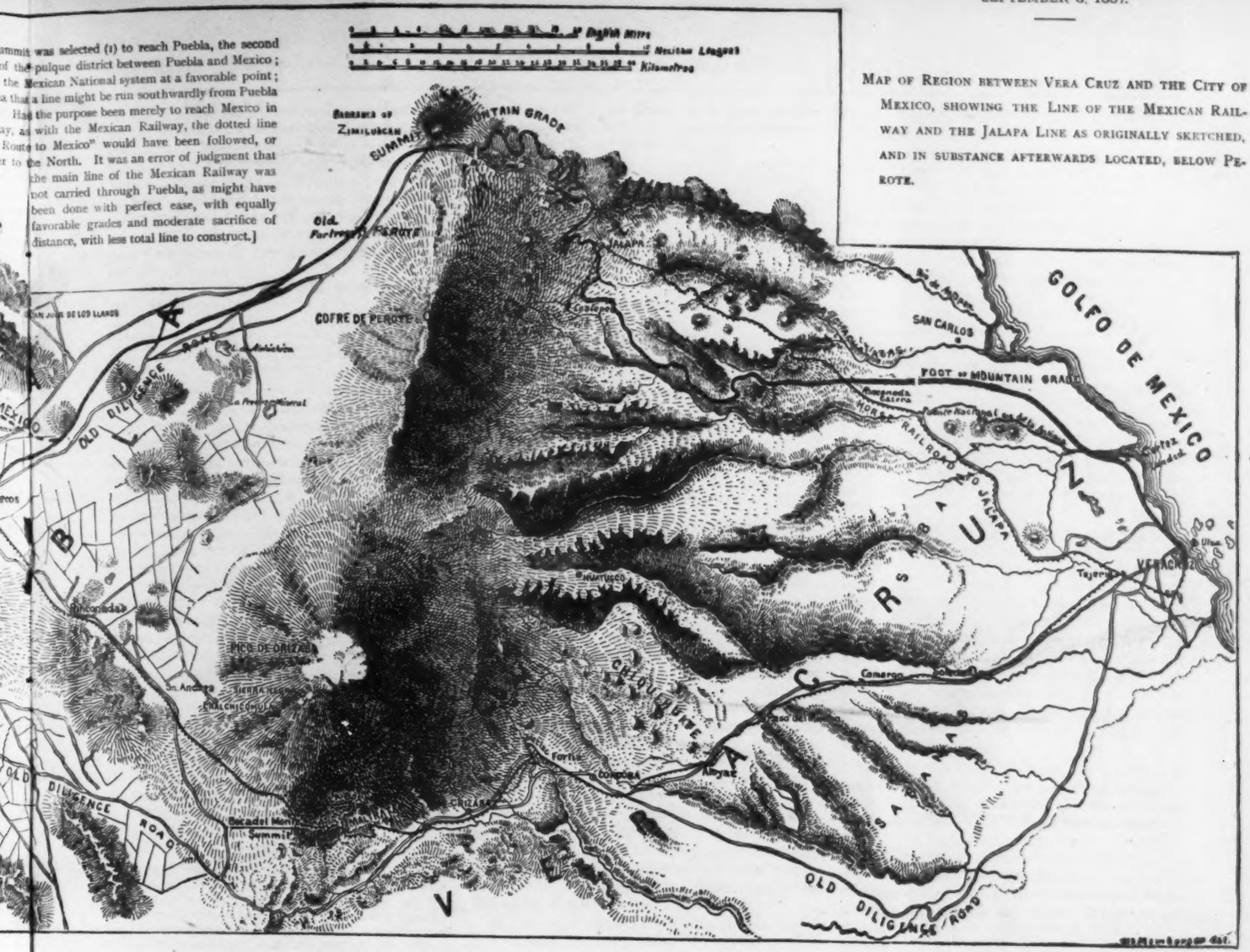

Rugged Hillocks of Volcanic Rock Overlaid with thin Soil.
Extending Creep to the Canada 20 Miles.
LAVA FLOW FROM PEROTE
Flat and Steep Plains of Lava — Porous and much shattered — Overlaid with thin
KILOMETERS.
MILES.
LAS VIGAS.
Section 9.
Section 8.

Section.	Location of Sections.	Length. By Air-Line from Beginning to End of Section.	Length. By Located Line.	Increase by Development.
9	Summit to end of ragged-cliff work	8.5 kilos.	19.0 kilos.	100 to 224
8	End-section 9 to middle of third horseshoe curve	7.5 "	15.0 "	100 to 200
7	Middle of third horseshoe to middle of flat, opposite Jalapa	7.9 "	20.5 "	100 to 260
		23.9 "	54.5 "	100 to 228
7-8-9	Air-line from summit to Jalapa	21.5 "	54.5 "	100 to 254

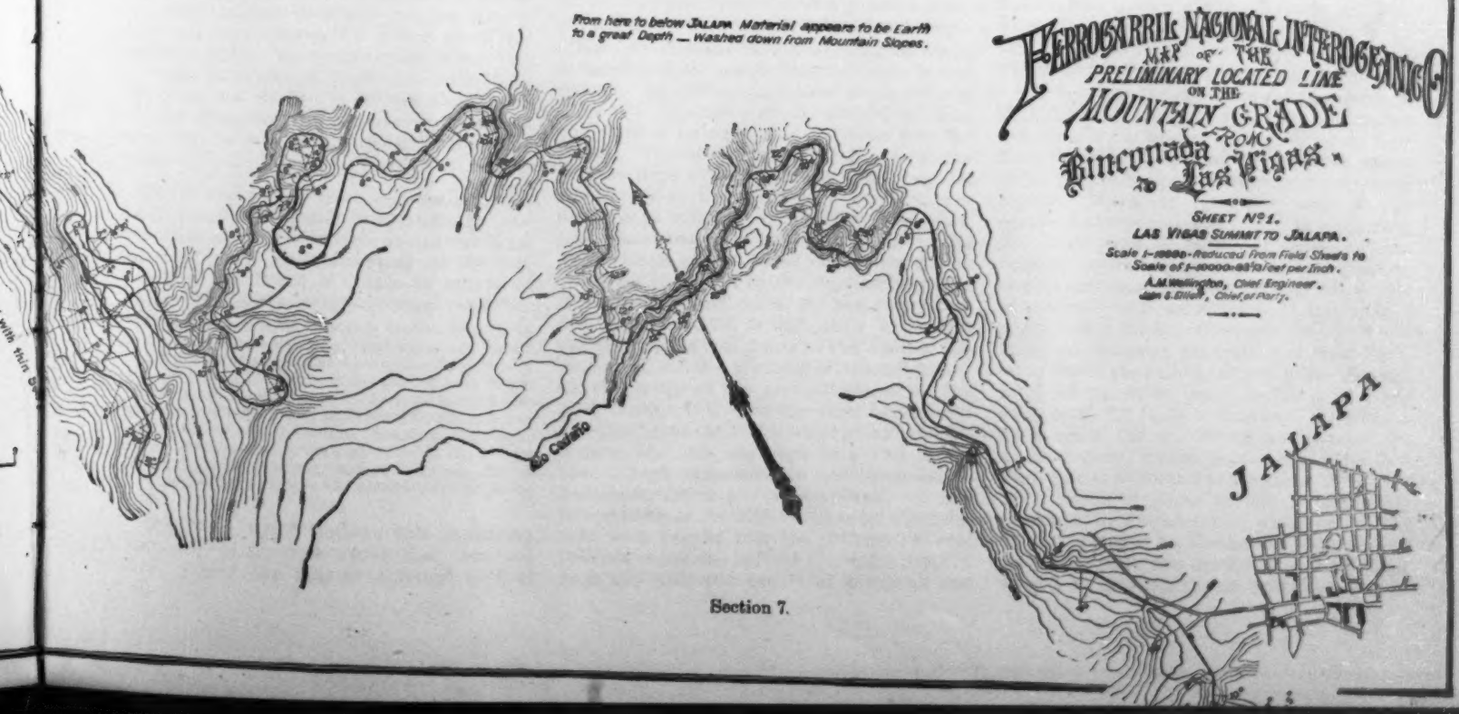
[The de
somewhat
(100-foot ch

mmit was selected (1) to reach Puebla, the second of the pulque district between Puebla and Mexico; the Mexican National system at a favorable point; a that a line might be run southwardly from Puebla Had the purpose been merely to reach Mexico in ay, as with the Mexican Railway, the dotted line Route to Mexico" would have been followed, or r to the North. It was an error of judgment that the main line of the Mexican Railway was not carried through Puebla, as might have been done with perfect ease, with equally favorable grades and moderate sacrifice of distance, with less total line to construct.]

MAP OF REGION BETWEEN VERA CRUZ AND THE CITY OF MEXICO, SHOWING THE LINE OF THE MEXICAN RAILWAY AND THE JALAPA LINE AS ORIGINALLY SKETCHED, AND IN SUBSTANCE AFTERWARDS LOCATED, BELOW PEROTE.



he degrees of curve given are for 20-metre chain (chord of 65.6 ft.), and are what more than two thirds of the degree of the curves by the foot system oot chords). Profile of this line is shown in Fig. 310.]


From here to below JALAPA Material appears to be Earth to a great Depth — Washed down from Mountain Slopes.
FERROCARRIL NACIONAL INTEROCEANICO
MAP OF THE PRELIMINARY LOCATED LINE ON THE MOUNTAIN GRADE FROM Rinconada TO Las Vigas.
SHEET No 1.
LAS VIGAS SUMMIT TO JALAPA.
Scale 1-20000 - Reduced from Field Sheets to Scale of 1-40000 = 63⅓ feet per Inch.
A.M. Wellington, Chief Engineer.
Jas S. Elliott, Chief of Party.
JALAPA

Section 7.

ample of what takes place in many cities. By actual observation it was found that during the twelve hours covered, Genesee St. was blocked by passing trains and engines 2 h., 49 min. in the aggregate; Washington St. 2 h., 12 min.; Michigan St. (crossed 193 times by engines and trains),6 h., 52 min. and Louisiana St. (crossed 288 times by engines and trains), over 7 hours out of the 12 busiest hours of the day.

The number of people and teams crossing were as follows:

Street.	Teams.	Persons.
Genesee	338	753
Washington	1,803	5,734
Michigan	2,662	12,986
Louisiana	2,138	6,405
Total	6,901	25,877

In other words, the equivalent of nearly a sixth of the entire population of the city crossed the tracks on these four streets at the risk of life and limb in twelve hours of one day. The loss by delay of teams alone is placed at $100,000 a year. These naked figures call for no comment. They tell plainly enough that the loss from these grade crossings is vastly greater than the interest on the cost of over or under-crossings, without speaking of loss of life, which is always great. At one crossing in Jersey City it has been shown that if each life lost be estimated at $300, there are enough lost to pay interest at 4 per cent. on the entire estimated cost of the proposed Pennsylvania overhead tracks. Yet it is regarded as—and is, as things go—quite a proof of enterprise and public spirit that the Pennsylvania should plan such an improvement.

THE following letter has a certain moral that we forbear to comment on, but commend to the attention of all our subscribers who have to do with the letting of contracts. We find it in the Leavenworth *Times:*

KANSAS CITY, MO., Aug. 3, 1887.

EDITOR TIMES, *Dear Sir:*—Hearing that a bridge had fallen down in your city, I stopped off to see what chance there was to get a contract for a new one, but found a contract had been made for a $600 wooden one. Lucky contractors. Next time please advertise the letting, and I will save your city $300 on just such a bridge, or will build an iron one for less than the $600 to be paid for the wooden one. I understand you have a large bridge works in Leavenworth, but their agent told me to-day, that they were not asked to bid on it.

Very respectfully, J. W. BROWN, Agent.

The *Times* remarks that if Mr. BROWN were better posted on the way things are done in Leavenworth, he would not be so surprised at a little matter of that kind, and after all, is it so very different from the way in which immense railroad contracts are let without any real competition by notice to a few favorites only? We congratulate those who get their contracts through such lettings on the quiet, but we do not believe that it is a paying thing for the companies, although done for the most part with the best of motives.

THE slowness with which reforms progress in England is curiously illustrated by the condition of their passenger equipment in respect to brakes. In commenting on the last report of the Board of Trade in regard to them, *Herapath's Railway Journal* remarks:

"It is satisfactory to note that *marked progress* is being made in the adoption of these safety appliances. Only 9 *per cent of engines and 15 per cent. of carriages are now without them* [*i. e.*, without any kind of train brake, automatic or non-automatic.—ED.] and taking all kinds of traffic on all the lines of the United Kingdom, 85 per cent. of the train miles run have been fitted. Only eight years ago 61 per cent. of the engines and 75 per cent. of the carriages were without continuous brakes. *We are thus approaching something like possible perfection in the matter.*"

The table which follows this gratifying summary of progress shows that this one small island has still 13 different kind of brakes in use, 7 of them on a considerable scale, and nearly half of the whole equipment non-automatic, as follows:

Brakes which comply with requirements of Board of Trade.	Fitted Dec. 31, 1886. Engines.	Carriages & other vehicles.
Automatic friction	1	8
Automatic vacuum	2,433	12,611
Clark and Webb's (North London Line)	89	374
Steel McInnes	—	37
Westinghouse automatic	1,757	14,427
Total	4,280	27,457
Percentage of total stock (complying)	54 p. ct.	53 p. ct.
Brakes which do not comply with requirements of Board of Trade.		
Chain brake	680	1,662
Fay's	—	993
Newall's	—	319
Fay and Newall's	—	108
Smith's vacuum	1,353	7,936
W. Parker Smith's automatic	—	3
Vacuum	879	5,395
Westinghouse	54	350
Total and percentage	2,966 or 37 p. ct.	16,757 or 32 p. ct.

The Quality of Schuylkill Water in Philadelphia.

In view of the long continued outcry concerning the potable qualities of Schuylkill water in Philadelphia, the expenditure of large sums of money in seeking a new and more distant source, and the somewhat conflicting but generally condemnatory opinions of a series of chemists who have analyzed this water, the late assertion of the Chief Engineer of the Water Department that the Schuylkill supply is sufficient in quantity for 30 years to come, and is "good enough" in quality for all present use, sounds rather strange.

There seems to be no doubt about the first assertion, for a minimum flow of 245,000,000 galls. daily in the river is enough for quite an increase upon the present estimated population of 975,000 inhabitants. But the question of quality is open to discussion.

As a natural water supply the river Schuylkill should be unequalled; its water is soft and contains but little mineral matter, and it runs in a shallow stream over a rocky bed that is cut up into numerous falls and rapids that would seem to give it every desired opportunity for aeration, and the destruction of organic matter injected into it. The small percentages of lime and magnesia render it suitable both for manufacturing and household purposes, and its volume is such as to render its dangerous pollution a question of abnormal quantity in the polluting elements.

But with all these natural advantages, there is another and less satisfactory side to the picture. On the drainage area above the city there is a population of over 350,000, which in one form or another casts its waste into the stream. This sewage matter, however, seems to have little effect upon the quality of the city supply, as it arrives very generally in a fairly good condition at the Flat Rock dam just above the city. This fact is due to the oxygenation of the water during its course down the river, and to the further fact that free sulphuric acid, one of the best correctives for free ammonia, is furnished in useful quantity by the coal mines at the head of the Schuylkill and the leaching of the sulphur in the slag-heaps of the many furnaces on the river banks. It is when the water touches the city limits that the real work of pollution commences, and this has been very bad in the past, though measures are now being taken, and construction partly completed, for the interception of the filth that has for a generation been poured into the Fairmount pool (whence comes the bulk of the water supply), from the mills and sewers of Manyunk and other manufacturing villages and from at least four city sewers.

Chemical analyses of the Schuylkill water taken at the city and points above the city, show that any real danger to be apprehended from its common use is almost entirely due to contamination after it reaches the city limits, bad as are some of the local conditions upon its upper course. The water at the main city pumping station shows 2½ times as much free ammonia, nearly twice as much albuminoid ammonia, five times as much nitrous acid and one and one-half times as much chlorine as samples taken from the river 20 miles above the city. Whether the new works now under construction will entirely eliminate this pollution remains to be seen; but we have the assertion of reliable chemists that the water will be permanently restored to good condition *if* a masonry intercepting sewer can be made tight enough to remove all the objectionable matter to a point below the Fairmount Dam.

The fact, however, remains that the present supply is an impure one, the works intended to better existing bad conditions are yet untested in their entirety, and that the water taken into a distribution system almost from the heart of a city of nearly one million inhabitants must always be open to suspicion. In this connection the advice of the late Mr. KIRKWOOD is pertinent. This eminent authority on water supply once said that the best treatment for a water suspected of sewage contamination was—to let it alone and go elsewhere for the supply.

We have not touched upon the question of muddy water, the feature most complained of by the ordinary consumer because it is the most apparent. This mud or sedimentary matter in suspension is rarely dangerous though very objectionable, and it can be removed. But the proper filtration of a quantity of water sufficient for the daily needs of Philadelphia will require an outlay for plant and annual maintenance that would represent the interest on a sum of money that could be better invested in obtaining a naturally purer supply. If they continue to use Schuylkill water for the next 30 years, extensive settling basins or filter beds, or both, will be an absolute necessity, as recommended by the present chief in his late report. But when the next generation is driven to seek another source of supply, this plant will be just that much waste and unavailable material on their hands. Pumps and boilers are marketable articles, when no longer needed for use, but a filter-bed would be rather unsaleable, and in fact cost money in its destruction or removal.

The fact that the mortality per thousand, in Philadelphia, is "one less than in London, two less than Paris and seven less than in New York," might be accounted for upon other grounds than that of a relatively purer water-supply. There are other and quite as important features to be considered in comparing the death-rates of different cities. Philadelphia covers an area of about 129 sq. miles, and its well sustained boast is that it is a "city of homes," with an average of less than 6 persons in a house. Compare this with the immense tenement population of New York, where twice the number of people are crowded into 100 sq. miles less territory, and the average of "13 souls to a house" gives but a false idea of the real living conditions of the mass of poor, whose deaths swell the New York rate to abnormal proportions. The New York tenement house system is practically unknown in Philadelphia, while out of the 23,000 tenements on Manhattan Island, 18,966 have more than one family on a floor. And special returns made some years ago showed

that 53 per cent. of the total mortality, exclusive of institutions, came from this class of dwellings. Out of 1000 houses in the 10th Ward, in 1879, 324 contained from 6 to 8 families; 272, from 8 to 12; 110, from 18 to 16; 162, from 16 to 20, and 62 tenement houses contained 20 or more families. The larger portion of these houses contained not less than 50 persons, and nearly 300 of them were occupied by from 70 to 100 individuals. Under such conditions it is not a question of the quality of the water consumed, but it is the almost absolute lack of water for uses other than personal consumption—the cleansing of the living rooms of the seeds of all manner of disease, and of the persons of the filthy occupants of these rooms. The fact of the matter is that in purity of source the Schuylkill will bear no comparison with the Croton water-shed, and the water of this latter stream must not be charged with a death-rate for which it is in nowise responsible.

We might add here that the usual method of dividing the total death-rate over the entire population of a large city is all wrong, and likely to lead to very unjust conclusions. The mortality is much affected by the conditions surrounding the resident. And these should be considered in studying the effect of a common water supply, which if impure should affect all alike. The force of this separation of mortality into districts is well shown in the Statistics of London for 1885. Divided over the whole city the death-rate was 21.5 per 1,000. But for the 39 sanitary districts it stood as follows:—Plumstead, 14.6; Hampstead, 16.3 Kensington, 16.6; Lewisham, 18; Hackney, 18.9; and St. Georges, Hanover Square, 19; while the higher rates stood—London (city) 28.2; St. Saviour, 28.7; St. Luke, 29; St. Giles, 30.5; Holborn 30.7 and St. George-in-the-East, 35.7. To anyone at all familiar with London, this exhibit shows that the greatest mortality is in the homes of the London poor, where they are packed in dense masses, are denied the light and air of more favored localities and consume food of low and objectionable quality; where, in a word, they are subjected to all the trials and want that are only known to the lowest classes in a great city. If the mortality statistics for Philadelphia were divided in a similar manner they might tell a different story. Though even then that city lacks the densely populated areas that make the conditions so widely different in less favored cities.

If we compare Philadelphia with some other and older cities, this death-rate standard figures out even less favorably. Philadelphia has a death-rate of about 21 per 1000, with its well scattered population of less than 6 individuals to a house. Paris averages 29 people to a house, and has a death-rate of 26.3; and Berlin with the same death-rate has 63 inhabitants per house; both these cities have more than twice the population of Philadelphia. London approaches most nearly to the Quaker City with an average of 8 persons to a house, and yet with four times the population its death-rate has been steadily decreasing, and was only 21.5 per 1,000 in 1885, the last returns just at hand.

If this death-rate shows anything, it is that Philadelphia is peculiarly favored in its freedom from crowding, topographical situation and healthy surroundings, and that it preserves a low mortality rate in spite of notoriously bad drainage, and a water supply that is far from being above suspicion. With an improvement in its sewerage, and water brought from a source of undoubted purity, there is no telling how long life might be prolonged in that city; and it might again have cases of longevity equal to that veteran of 102 years, of the last century, of whom FRANKLIN once remarked that it was impossible to say how long people could live in Philadelphia "until old NEDDY DRINKER died."

The Value of a Name.

The promoters of the Manchester Ship Canal are said to have already expended $1,750,000 in furthering their scheme, and the first sod has yet to be turned. As the total estimated cost is $28,750,000 this represents a very handsome percentage of the amount to be expended, in simply "getting ready." The usual addition of 10 per cent. "for contingencies" would be far out in this case. In this preliminary expense sheet there is said to be a fee of $20,000 paid the late JAMES B. EADS for a professional opinion. If this is correct, and there seems to be little reason to doubt it, this is probably the largest professional single fee ever paid to an American engineer. And with all due credit to Mr. EADS, it shows the value of a wide reputation, as a man of sound natural judgment and experience in great undertakings, as compared with that of the more modest engineer proper who has only extensive but purely professional experience to recommend him.

The professional position of Mr. EADS, as an engineer, is rather difficult to define. He was a purely self-made man and entirely without what is recognized as a technical education as an engineer, and yet he possessed in a high degree and made excellent use of that inherent something without which the best trained engineer in the world will not succeed. He instinctively understood both the management of men and matter, and without the knowledge necessary to figure a strain-sheet, not only was he the executive engineer in building what was in its day the bridge of boldest span, but he also so impressed others who were not engineers with his ability to carry out his projects and with his sound judgment in advancing plans, that they furnished him with all the money required. His skill in managing affairs was well exemplified in this case, where the actual cost of this then novel feat of engineering was about $12,000,000 on an original estimate of less than $5,000,000. His great work in opening the mouth of the Mississippi to navigation was also the result of the possession of other accomplishments than that of pure engineering knowledge alone. He doubtless had an advantage over engineers generally in having made almost a life-study of the river he proposed to improve, and he had become familiar with its vagaries and power by long service in that best of all schools-the school of experience. But when he had convinced himself that he could accomplish the task before him, he had all the courage of his convictions, and risked his own fortune, and persuaded others to risk theirs, in battling professional, personal and political prejudice, and only won by finally offering to do all he promised, or no pay. When it came to the work the engineering was really simple and what there was of it was carried out by other hands. His supreme executive ability and confidence in himself, and not his engineering skill or reputation, was what won the battle.

And it was the boldness of his projects and the marked success with which he found men and means to carry them out that made his name famous on both sides of the Atlantic, and made an expression of his judgment valuable to the promoters of the Manchester canal. But after all it was the name they paid for; purely professional advice, in more elaborate detail, could have been purchased for a fraction of the sum mentioned, and they doubtless had such already in abundance. They wanted to have their views backed-up by a name that would impress the public and establish public confidence in the enterprise, and encourage the public to invest that money without which the scheme could not succeed. It is an every-day method in England, and is the usual way in which the dukes and other titled personages there are made generally useful. And it is after all a legitimate procedure when the scheme is an honest one, as this one was, and Mr. EADS undoubtedly gave the same opinion he would have expressed in his own country for a much smaller fee. The only difference was that that opinion was more valuable in England than in America. The investing class of Englishmen are accustomed to the worship of name or title, even to the extent of risking their fortunes in any project that has a sufficient number of coronets on its Board; while the more cautious American investor is apt to examine the matter for himself and gamble upon his own judgment in such matters, rather than upon the opinion of some one else, no matter how high the personal or professional standing of the other party may be.

CORRESPONDENCE.

On the New Method of Dimensioning.

CONNELLYS SPRINGS, N. C., Aug. 23, 1887.

EDITOR ENGINEERING NEWS:

In your issue of August 20, is a criticism by Mr. OTTEWELL of my previous note "*On the New Method of Dimensioning*," which merits notice, and to which I shall beg a little space to briefly reply to.

First, with regard to the unfortunate *hanger*, which is attracting by far too large a share of attention, let me state that if I were convinced that it suffered no greater excess of strain due to impact, than a counter, I would advise both to be proportioned for 7500 lbs. per sq. in. I am only taking proper practical precautions, however, it seems to me, when I use a less unit stress for the hanger, simply because it is differently situated to the counters and thus *may* receive more direct shock from the bouncing of a train; or the unbalanced drivers on the down stroke, also because, when there are two hangers to each apex, the share of the load borne by each is not so accurately devided between them (in fact one may not be "taut" as mentioned before) as in the case of bridge ties, especially after long use; lastly for the reason that it is doubtful whether iron bent in the form of a semi-circle is as strong as straight rods and I know of no direct experiment on this point to enlighten me.

In place of a less unit strain, it is more convenient to add a certain percentage to the live load to cover these *extra* contingencies and then apply formula (1.)

Formula (1) then does not "fail" for the hanger, because it was never designed for it any more than for machinery; but it is intended solely for the chords and ties of a bridge. Some of the reasons above for adding a per cent. to the live load for hangers apply likewise to "suspenders," though not to the same extent, and I think the same unit stress for them as for counters is allowable.

Well, bidding a final adieu to the hanger, let us next take up, the derivation of Mr. OTTEWELL'S formula VIII, from which he deduces Table III given on page 128.

The method of derivation I cannot object to: in fact, it appears to me to be much more "logical" than Mr. OTTEWELL'S former, rather fanciful derivation of formula (*A*); but objection must be urged to formula III, $a'' = 25{,}000\ (1 + \theta)$, from which VIII is eventually derived, so far as the coefficient of θ is taken as unity, for which we have no sufficient experimental basis.

The whole question is thus narrowed down to a proper choice of this coefficient, for I infer that Mr OTTEWELL agrees that the allowance for impact should be so chosen that the values of p should sufficiently agree with the records of the superadded deflection due to the motion of the train, and I presume it plain that the corresponding values of p should be the same for steel or iron bridges of the same design, as emphasized in my last letter to ENGINEERING NEWS (see Vol. XVIII, page 129).

We have therefore only to go to the records to find the corresponding LAUNHARDT formula. As I have

given my reasons in full for the choice of ½ for the coefficient of θ for iron and ⅓ for mild steel, it is not necessary to repeat them here. I regard both of these coefficients as possibly too low in the case of *experiments* on small test pieces, where the load is very suddenly and rapidly applied millions of times; but the reference to the original LAUNHARDT formula and WÖHLERS experiments will show that for a less number of repetitions than the 10 to 40 millions, that the coefficient of θ diminishes, and becomes quite small for a few hundred thousand, which is likely nearer the number to be provided for in our bridges than the former. For this reason, and further, because in the case of the experiments, the load is not more suddenly applied, but very rapidly repeated (which does not obtain in the case of bridge members). I think that "it is advisable to incline towards minimum values" of the coefficients of θ.

It is certainly astonishing that Mr. OTTEWELL, with WEYRAUCH'S formulas before him, should object to different coefficients of θ for steel and for iron. For an all live load, I give (impact included) 7500 *lbs. per sq. in.* unit stress for iron and 9000 for mild steel; for all dead load, 15,000 and 20,250 *lbs.* respectively. As steel is more brittle than iron, the extremes should be greater undoubtedly. As my formula (1) and the new formula (10) allow by assumption, the same percentages p for the increased stress due to the motion of the live load, the wider extremes for steel are seen to come directly from WÖHLER'S experiments.

I, unfortunately, have no books with me to give some of these experiments; but if we take the WEYRAUCH formulas deduced from them, we have the extremes for iron (safe stress) for all live and for all dead load, 10,000 and 15,000 lbs. respectively, whereas for hard steel, if we put the first limit (by way of better comparison) at 10,000, the limit for all dead load is $10{,}000\ (1 + \frac{1}{3}) = 22{,}000$ lbs.

This is the direct result of the most carefully conducted experiments, by WÖHLER, covering a space of many years, and it is strange that Mr. OTTEWELL should utterly ignore them in this regard.

It is admitted that we have no similar experiments on mild steel; but I think, from analogy, that the extremes for mild steel should be farther apart than for even our best bar iron, and that the limits have been judiciously chosen above the steps of the argument, having been carefully given on page 129 of the current volume.

One other point in Mr. OTTEWELL'S reasonings, which seems to have influenced him a great deal in deriving his formula (*A*), needs to be noticed.

RANKINE says, that "a bar to resist with safety the sudden application of a given pull, requires to have twice the strength that is necessary to resist the gradual application, and steady action of the same pull."

The theory which leads up to this dictum is correct and the principle can be derived from many different courses of reasoning; but whether it is that a theoretical "sudden application of a load" to a rod or beam is an impossibility or for whatever reason, it is well known that a so called sudden application of a load to a tie rod does not cause a very much greater elongation than a steady pull of the same number of pounds (STONEY, I think, gives an account of some experiments bearing on this point); further a so called sudden application of a load of half the breaking weight will not rupture a rod or beam by any means. In fact WÖHLER and SPANGENBERG as well as Mr. BENJAMIN BAKER, in all their experiments upon repetitions of stress, caused the repetitions to succeed each other so rapidly, that even if they had set out with the intention of applying the loads as "suddenly" as possible, they could not have succeeded much better than in their experiments; and yet they all found that for only a few thousand repetitions of this (nearly) suddenly applied stress that the breaking stress did not vary much from that due to a steady load gradually applied.

It is the continued repetition of the stress that operated more powerfully in diminishing the breaking unit stress than the fact of sudden applications, one or more times applied. For the low grade iron experimented on WÖHLER in fact found, for 10 million repetitions, that the iron broke under 30,000 lbs. per sq. in., whereas under a quiescent load (no repetitions), it broke under only 45,000 lbs. The amount for the load (nearly) suddenly applied only a few thousand times was much nearer the 45,000 than the 30,000.

All of these facts show that the principle enunciated above by RANKINE is not a good rule to work by and that it must not be made the basis of any working formula for unit stress, particularly when experiments are not lacking.

I hope that I have answered the principal objections of Mr. OTTEWELL to the use of formulæ (1) and (10) and those dependent on them. As to some minor points, that scarcely need special mention, however, I shall not tax the readers of this journal by entering into, especially as I have no taste for controversy *per se*, and hope that I have said all that is necessary to throw light upon the "New Method of Dimensioning." Respectfully,

WM. CAIN.

"All at once and nothing first
Just as bubbles do, when they burst."

All at Once, and Nothing First.

Board of Railroad Commissioners.
ALBANY, N. Y., July 25, 1887.

EDITOR ENGINEERING NEWS:

I send by this mail photographs of an accident on the Canadian Pacific Railway, which may not be uninteresting although it can hardly be considered news.

The bridge was over the Petewawa river, about ten miles from Pembroke, Ont., and judging from the photograph the span was about 125 or 130 ft. It was evidently one of Clarke, Reeves & Co's bridges, and knowing the high standard required for bridge work on this road we may conclude that this was as good a bridge as could be built *of the kind*.

On June 7, 1886, an east bound freight train moving at about 25 miles per hour, reached the bridge. Just forward of the caboose in this train was a steam shovel, the wreck of which is seen on the right of the large view. This shovel was just a bit too high to pass under the portal bracing, consequently when the portal was struck the end posts were lifted off their seats and dropped into the river, and the whole span settled squarely down as represented, killing two men and injuring three others.

I think the time is not far distant when you will agree with me that the only safe bridge to build for *all* spans—certainly for all "through" spans—is a riveted lattice.

Yours truly,
CHAS. F. STOWELL.

[We publish this cut chiefly for the benefit of our esteemed contemporary, *The Engineer*, that it may have a text for another article to instruct the guileless colonist as to the right shop to buy bridges in. But it is also curious to note the way in which the whole bridge came to pieces in all its joints and details as a result of the fall. We do not know that that is necessarily a fault, if a bridge is to fall at all it might as well fall all to pieces as fall half to pieces, and the question still remains, —what would have happened to a riveted lattice if a heavy steam shovel had begun stripping off its top lateral bracing? No bridge can be built (or rather, is built) to stand heavy blows in such a locality. Still, there is an obvious moral, and we leave every one to draw it.—ED. ENG. NEWS.

PERSONAL.

Mr. THOMAS O. BOLGER, of Belleville, Ont., has been appointed City Engineer of Kingston, Ont., Canada, at a salary of $1,500 per annum.

Col. and Brvt. Maj. Gen. JOHN G. PARKE, of the Corps of Engineers, enters this week upon his duties as Superintendent of the U. S Military Academy, succeeding Brig. Gen. Wesley Merritt.

Mr. ARTHUR S.C. WURTELE has been appointed Deputy State Engineer, by Mr. ELNATHAN SWEET, State Engineer, vice Mr. JOHN BOGART resigned. Mr. WURTELE, is about 45 years old, says the *Albany Argus*, is a native of Buffalo, served a number of years in the office of CHARLES FISHER, Chief Engineer of the N. Y. Central R. R., and has been special agent in the office of the Superintendent of Public Works for some time past.

Mr. WILLIAM HALE, who was for many years connected with the engineering department of the Central Vermont Railroad, and to whom was due a large part of the original location of that line, is probably one of the oldest veterans of the profession now in the field. For a number of years he has been content to leave active work in the profession to younger men, but this summer he has been induced to "renew his youth" and join a party on the locating survey of the New York & Boston Rapid Transit road, and notwithstanding his eighty odd years, is said to to be able to perform an amount of "rapid transit" on his own account which would weary many a younger man. His large experience and mature judgment, combined with that natural aptitude for the work which we are prone to believe was more common in "engineers of the old school" than nowadays, render his presence no less valuable than it is novel from his great age.

Mr. W. J. MURPHY, Superintendent of the Buffalo division of the New York, Lake Erie & Western R. R., has been appointed General Superintendent, to succeed Mr. B. THOMAS, who has resigned.

Mr. M. E. WATTLES, Superintendent of the Kalamazoo Division of the Lake Shore & Michigan Southern R. R., has been tendered the position of General Superintendent of the Chicago, Kansas & Nebraska R. R., (the Rock Island's western extension.) He is to assume charge of the construction of the remainder of the division and assume general charge when completed. Mr. WATTLES built the Nickle-Plate from Fort Wayne to Chicago, and has been prominently connected with the Lake Shore for 20 years.

A circular has been issued from the President's office of the St. Louis, Vandalia & Terre Haute R. R. Co., announcing the retirement of C. C. WAITE as General Manager and C. NEILSON as General Superintendent, which offices they held on the Cincinnati, Hamilton & Dayton R. R. Their jurisdiction was extended to the Vandalia when Ives bought the road. Col. HILL, as Assistant General Manager will remain at St. Louis, President MCKEEN discharging the duties of General Manager. F. H. SHORT retires as Secretary and Treasurer, and GEORGE E. FARINGTON, the former Secretary, and J. W. CARPT, former Treasurer, resume the sepositions.

General GEORGE S. GREENE and Messrs. WILLIAM G. HAMILTON and STEVENSON TOWLE have been appointed by the Board of Direction of the American Society of Civil Engineers, at the request of the Board of Street Openings of the City of New York, a committee on the subject of the widening of Elm street. The committee appointed to consider the same subject by the American Society of Mechanical Engineers consists of Messrs. CHARLES E. EMERY, C. T. PORTER and S. W. BALDWIN.

SPENCER FULLERTON BAIRD, who died on Aug. 19, and was one of the foremost scientists and naturalists of his day, was born in Reading, Pa., on Feb. 3, 1823, and graduated in 1840 from Dickinson College, Carlisle, Pa. He studied medicine but did not graduate, being from the first an earnest student of natural history. In 1845 he was professor of natural history at Dickinson College, and later was also professor of chemistry. In 1850 he was appointed Assistant Superintendent of the Smithsonian Institute, and thenceforward was connected with that institution, succeeding Prof. JOSEPH HENRY, as its Secretary and official head in 1878. His scientific labors have covered a wide field and the results of his researches have been recognized over the scientific world. His literary work has been something enormous, covering to Jan. 1, 1882, 1,063 titles, of which 200 are formal contributions to scientific literature, and the remainder brief notices, critical reviews, reports, schedules, etc. His great work has been in connection with his appointment, in 1871, as Commissioner of Fish and Fisheries.

Col. JOEL. B. CLOUGH, of the construction department of the Northern Pacific R. R., died of pneumonia, August 23, at Helena, Mont. Col. CLOUGH was born in 1823 at Palmer, Mass. He studied at the Wesleyan academy, Wilbereham, Mass., and at the Wesleyan university, Middletown, Conn., from which latter institution he graduated with the degree of Civil Engineer. He was engaged in engineering work on various railroads in Ohio until 1851, when he went South. After building several railroads in Alabama and Tennessee, he moved to Minneapolis at the breaking out of the war in 1861. He was engaged in farming at a point near Hopkins station until 1863, when he took charge of railroad and bridge construction for the army of the Potomac. He ranked as a colonel and commanded a corps of 640 men in the work of rebuilding railroads and bridges destroyed by the rebels. His health failing after a year's service, he was honorably discharged, and returned to his farm near Minneapolis. After a year or so on the farm his health recovered sufficiently to allow him to take charge of the construction of the St. Paul & Pacific (now Manitoba) and Hastings & Dakota railways. He was elected City Engineer of Minneapolis in 1869, and again in 1874. The city is indebted to Col. CLOUGH for her system of street numbering, for the boulevard strips between the sidewalk and gutter on many of the finest streets and avenues, and for many excellent features of her water works system. During the interval between his two terms as City Engineer he constructed the Minneapolis & St. Louis R. R., and portions of what is now the Northern Pacific. After another period of farming in 1880 he became Assistant Engineer of the Northern Pacific under Gen. ADNA ANDERSON. Soon after he was made Chief of Construction which position he held at the time of his death. He had charge of the construction of the main line from Bismarck to Livingston, of the National Park branch, and of the line from Superior to Ashland, Wis. At the time of his death he was superintending the construction of five branch roads leading into the mining region from points near Helena. He was deservedly esteemed as a citizen and official, and his sudden death will be greatly regretted by all who were personally acquainted with him.

ALVAN CLARK, the most famed maker of telescopes in the world, died at Cambridge, Mass., on Aug. 19. Mr. CLARK was born in Ashfield, Mass., March 8, 1804. The son of a farmer, in 1826 he obtained a position in Lowell as a designer and engraver for the calico printers of that town. In 1835 he abandoned this business and opened a studio in Boston as a miniature painter and for 20 years thereafter he followed the profession of an artist. His son ALVAN G. CLARK took the engineering course of Andover about 1844, and the father becoming interested in the scientific studies of the son, first turned his attention to what was to become his life work. They experimented together and succeeding in making a reflecting telescope which was highly approved of by one of the Cambridge professors and the makers advised to go on in their work. Having succeeded with a speculum, lenses were next tried and the result was so satisfactory that both father and son gave up their other pursuits and devoted themselves to the manufacture of telescopes.

The Rev. W. R. DAWES was the first Englishman to order a glass when their fame had reached that country. The glass came in 1853, and did such fine work for this prominent astronomer, that it made their foreign reputation, and many orders from abroad followed. They began by making 6 in. objectives, and gradually increased in size until 1860 they received an order for an 18 in. lense. Up to that time 15 in. was the diameter of the largest lense in the world. This new order came from the University of Michigan, but the civil war prevented its acceptance, and it was sold to the Astronomical Society of Chicago, Ill. With this glass Mr. CLARK and his son discovered the companion of Sirius on Jan. 31, 1862, and they were awarded the Lalande medal by the French Academy for the discovery. When in final position in 1862, this same great glass showed 20 stars hitherto unseen in the nebula of Orion.

In 1870 the firm contracted for a telescope for the Naval Observatory in Washington, which was finished in January, 1871; but though showing remarkable results, more work was put upon it, and it was not until in 1873 that it was finally mounted. A duplicate of this glass was made for Mr. J. S. MCCORMICK, of Chicago, for the Washington and Lee University. About this same time they commenced the manufacture of the famous Russian lense. This cost $30,000, and had a clear aperture of 30 ins., a focal distance of 45 ft. and a magnifying power of 2,000 diameters. For this glass the Russian Academy gave a vote of thanks, and the Czar, a gold medal. Their greatest triumph is the 36-in glass for the Lick Observatory, costing $50,000. The main part was completed about a year ago, but the photographic lense is still unmade, the first one having been destroyed by an accident. Mr. CLARK'S two sons, ALVAN G. and GEO. B. CLARK survive him.

SOCIETY PROCEEDINGS.

The Master Car Builders' Association has through Mr. M. N. FORNEY, the Secretary, sent out circulars and cards for the letter-ballot ordered by the Minneapolis Convention upon the following subjects:—(1) Standard Type of Couplers; Riggings for non-automatic draw-gear; (3) Standard Axles, Journal-box, etc.: for cars of 60,000 lbs. capacity; (4) Standard shape (?) of lumber for freight cars.

PUBLICATIONS RECEIVED.

The Sanitation of Cities and Towns and Agricultural Utilization of Excretal Matters. Report on Improved Methods of Sewage Disposal and Water Supplies. By C. W. CHANCELLOR, M. D., Secretary State Board of Health of Maryland, etc. Maryland State Board of Health, publishers, 1887.

This is the result of a visit to Europe by Dr. CHANCELLOR, in the interest of the State Board of Health. The sanitation of smaller cities and towns is considered as well as the more elaborate and expensive plant and methods required for important cities. Commencing with the general question of sewage disposal, the author proceeds to briefly describe the different approved methods of treatment, including in these the Manchester and Rochdale systems, disposal by irrigation, A. B. C. process, Johnson filter-press, the pneumatic systems of Liernur, Shone and Berlier, and the domestic sanitary system of A. LeMarquand. The portion of the report upon Water Supply treats of the chemical properties of water, its artificial filtration and chemical analysis. An appendix describes a new system of sewage disposal invented by the author. The report is a handsome, illustrated document of 176 pages, with a good index, and reflects credit upon its compiler.

Elements of Analytical Mechanics. By PETER S. MICHIE, Prof. of Natural and Experimental Philosophy in the U. S. Military Academy, and Brevet Lt. Col. U. S. A. Second Edition. John Wiley & Sons, Publishers, New York, 1887. 9×6-in. pp. 292.

This is a revised edition of Prof. MICHIE'S original work, and is intended as a four-months course of instruction for students well versed in elementary mathematics, including the Calculus.

Civil and Mechanical Engineering, popularly and socially considered. By J. W. C. HALDANE, C. E. and M. E. London, 1887, E & F. N. SPON, publishers, 8½ × 5½ in. pp. 442; nine plates.

This production of Mr. HALDANE is a welcome novelty in the field of engineering literature. It is in no sense a text-book, but at the same time contains much useful information. It is rather a racy, personal chat on engineering generally, and marine engineering particularly, and embodies the ideas gleaned in a 35 years professional experience. His remarks upon the apprentice and premium system of England, and on the practice of engineering, and the duties of engineers, make most readable chapters, while the portions of the work devoted to ship-building, their engines, boilers and general system of construction, contains much sound advice pleasantly conveyed. The book is interspersed with anecdotes pertinent to the subject discussed, and altogether the volume commends itself for both pleasant and profitable reading, and well carries out the intent of the author in treating his subject from a popular and social standpoint.

Steel Tapes.*

BY JOHN L. CULLEY, MEM. C. E. CLUB OF CLEVELAND.

The plan upon which our government lands are surveyed is undoubtedly the best ever devised for such a purpose. The land being laid off in half-mile squares, the purchaser generally obtains so many whole sections and quarter sections. The law specifically determines how lost corners shall be restored, so that whatever errors there may be in the original government survey, they are confined within these comparatively narrow limits. The beauty of the system is that, the original lines being laid out north and south, and east and west, the bounds of the subsequent purchaser are, as a rule, laid off parallel to the original lines, and are, therefore, easily reproduced.

As the land increases in value, these purchases are subdivided again and again, whilst each successive subdivision is estimated by a more and more refined measurement. Finally the time comes when every precaution is taken to obtain the absolute dimensions of the land.

This process of refinement is noticeable in the field work of the better class of private surveyors of this country. Thus, the city of Cleveland was laid out from the Cuyahoga river Wilson Ave. in 1797, by the Connecticut Land Company. This survey—remarkably consistent and well executed—has a surplus of some 0.67 to 100, which is nearly uniform throughout the whole survey. The surveyors in this vicinity, of 60 and 70 years ago, used a surplus of from 0.17 to 0.25 per 100, whilst those of 40 and 50 years ago intentionally used a surplus of 0.08 per 100. Even these refinements were far in advance of those of observed angles, which were dependent upon the compass, whose closest reading was one-fourth of one degree.

With the introduction of the transit, reading angles to a fourth of a minute, this order was reversed. Then line measurements became the unknown quantity, whilst angle observations became a certainty.

The 66 and 100 ft. chains, each of 100 links, were, of course, the standard used by the old surveyors. There were three reasons why they could not be relied upon for accurate work:

1st. The sag, due to their weight, materially shortened their length when drawn to a line above the ground;

2d. Their lengths were constantly increasing from the strain in chaining and from the slight abrasions at each of the 600 wearing surfaces in every chain, and,

3d. They were liable to kink and shorten under the slightest provocation.

Their weight was no slight objection, especially if it came your turn to drag it over a recently thawed clay territory in the early spring. These objections

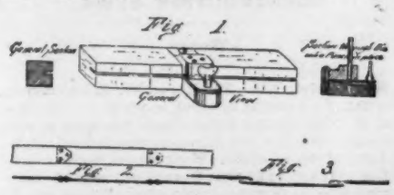
* From Journal of Association of Engineering Societies.

were practically overcome by the advent of the tempered steel tape.

It was about 1860 that the first steel tapes were imported and used in this country. It was not until 1873 that it was used in this city for general land surveys. Now nothing else is used here for either city or farm measurements. It is rapidly being applied to all branches of engineering measurements, nor will it be long ere the old chain with the Jacob staff will be counted with the relics of the past.

JAMES CHESTERMAN & Co., of Sheffield, England, are undoubtedly the largest manufacturers of steel tapes in the world. JAMES CHESTERMAN was the inventor of the steel tape, as well as of his processes of rolling, tempering, printing and of polishing, all of which he covered with letters patent.

GEO. M. EDDY & Co., of 351 and 353 Classon avenue, Brooklyn, N. Y., one of the largest manufacturers of tapes in this country, have been in this business since 1846, and have manufactured steel tapes since 1867. Their processes of manufacture are their own peculiar inventions, and like those of the English house, their processes are unlocked trade secrets. The distinguishing feature in the appearance of these two makes of steel tape is that, whilst the English is polished on all its faces and edges, the American is polished only on its edges and on the graduation; its other surfaces are a dull blue black. This distinction, however, disappears when the American tape has been used a short time. When new, the EDDY tape can be much more easily read than the



CHESTERMAN. Where parties use tapes sparingly this feature would be of great advantage. The expert, however, finds no trouble in reading either tape. Both are excellent tapes and well mounted, and are printed to each and every $\frac{1}{10}$ ft.

Whilst the knowledge of the more particular processes of manufacture is denied us, we are in possession of the main facts. After the rolled ribbons have been tempered and ground, in quantities of from one to two dozen at a time, they are laid upon an iron table 50 ft. long, which has a standard on each side. The standards are of government length at 62° F. The ribbons placed on this table in lines parallel to the standards, are made fast at one end, and a strain of 12 lbs. under a spring balance is applied at the other. They are then printed with a wash of varnish not affected by acid and then etched in a diluted nitric acid bath—the graduation being covered by the wax is left in the original surface of the tape.

The trade secrets are the results that have accrued to these enterprising manufacturers from long years of careful manipulations. I am indebted to L. BECKNAR, of Toledo, O., and GEO. M. EDDY & Co. for the above information.

Both of these firms are devoted exclusively to the tape trade, each manufacturing a variety of steel, as well of cloth tapes. CHESTERMAN & Co. are best known by their ⅜-in. web tape, whilst the PAINE tape is the better known tape of the EDDY house, which has the advantage of a narrow web (⅜ in.), offering slight resistance to the wind, and of being wound within a 4-in. reel.

All steel tapes are of the best French spring steel, capable of great strain without rupture, and of returning to their normal length when the strain is removed, and are of government standard at 62° F. Constantly using steel tapes for the last nine years, I have yet to find one that will not return to its normal length after the application of the most severe strain.

Nothing has contributed more to the general use of steel tapes than the introduction of *band chains*. The universal price of a good steel tape is $15. Band chains are sold at less than one-half the price of the old link chain. Band chains are narrow steel bands graduated into large divisions, frequently into 25 and 50 ft. lengths only, but usually into 5 and 10 ft. lengths, with each end foot into tenths. They are not a printed tape, hence they are called band chains, to distinguish them from steel tapes. They are not designed for the fine work to which the steel tape is adapted, but for rougher and more general work. They are thicker and narrower than steel tapes, and are therefore more adapted to their harder usage. They are admirably adapted to railroad work, and are a decided improvement upon the old chain for farm or country surveying.

Band chains are of a great variety of patterns. Although there are many excellent ones, I will now make mention only of three different makes.

1st. The HODGEMAN, manufactured by L. BECKMAN, 57 Adams street, Toledo, O., from the best *polished* blue steel wire, varying from $\frac{1}{32}$ to $\frac{1}{16}$ in. wide, and from No. 30 to No. 36 gauge thick, the cross-section of a single band chain being uniform throughout its length. The standard HODGEMAN is 100 ft. long, of ¼-in. No. 33 gauge. Babbit metal is fused on to the band at the desired points, into which the proper figures are stamped. The price of this tape is remarkably low. A 100-ft. line, graduated every 10 ft., costs $2.50; graduated every 5 ft., $3; or graduated every 10 ft. and the end foot into tenths, $3.75. Handles are 50c. a pair extra. They are used extensively in the West, and are indorsed by no less authority than J. B. DAVIS, of the University of Michigan.

2nd. The SAGER, manufactured and sold by the inventor, FREDERICK J. SAGER, C. E., at Marysville, O., is of the finest spring steel, and of only one size of scant $\frac{1}{32}$ in. thick by ¼ in. wide. They are very well made and gotten up. The graduation is performed by sinking figures into small copper plates, which are swedged around and brazed to the line. This tape, 100 ft. long including its large handles, costs graduated at ends only, $3.25; every 10 ft., $4.25; every 5 ft., $4.75; whilst his brass reel costs $4.00. These tapes are extensively used by railroad engineers, and largely by the surveyors of this State. Mr. SAGER has invented an ingenious riveting machine, for the repair of his tape.

3rd. The ROE, by JUSTUS ROE & SONS, Patchogue, Suffolk County, N. Y., is of fine tempered heavy spring steel, ¼ in. wide by $\frac{1}{24}$ in. thick. The graduation is made by riveting alternately, at the 5 and 10 ft. points, with brass rivets, brass and copper plates, into both faces of which the figures are stamped. The 10 ft. points are also designated by extra rivets in line along the band at these figure plates thus: 10 ft. by 1, 20 ft. by 2, 30 ft. by 3, 40 ft. by 4 and the center by 5 rivets, after the manner of the old chain 10-ft. tags. The ROES are the first and only makers that have successfully nickel plated steel tapes.

A 100-ft. line, including reel and handles, costs $4 and $5, according as it is graduated every 10 or 5 ft., the two end feet in each case being graduated to tenths; nickel plating for a 100-ft. line is $2 extra. This is undoubtedly the best band chain in the market. It costs more than either the SAGER or HODGEMAN, but has the advantage of a graduation made without the application of hot metal, which always weakens or destroys the web fibre. This objection is less applicable to the SAGER than to the HODGEMAN. The soft metal graduation of the HODGEMAN is liable to wear off in practice. No band tape graduation is as permanent as that of the printed steel tapes.

The reel is the band chain's weak point. Mr. SAGER has invented the only good one, but its price is too high for the trade. The band chain reel should be of good design and workmanship, capable of folding up compactly, and its cost should not exceed $1.50. A serious objection to band chains is their bulk when reeled, as their thickness prevents them being wound around a narrow coil. Band chains are not designed for thickly-populated districts, nor is it advisable to use them when the measurements require a steel tape to measure the fine divisions—a steel tape had better be used for the whole work. Band chains offer a small resistance to the wind, whilst steel tapes are finely graduated and reel into small cases. Tapes of the *Excelsior* type are unsuitable for field work. Their extreme width and weight cause them to sway in the wind and sag on level lines above the ground so as to render it impossible to measure work accurately with them. The *Excelsior* is manufactured by SEIDLER BROS., Leipsic, Germany. This tape has a very poor reel.

Upon the general subject of steel tapes I would recommend:

1st. Band chains should have handles at the front end only. The rear handle fouls the chain by catching in brush, etc., and its place should be supplied by a brass ring ⅝ in. in diameter.

2nd. The common steel tape is too wide. Its width should be reduced to $\frac{1}{16}$ in. and its thickness increased accordingly. Its reel, however, should never exceed 5 in. diameter or lose its charming capacity of entering your coat pocket.

It might also be stated that whilst the cost of band chains is reasonably low, steel tapes are exorbitantly high There is no good reason why a 100 ft. ⅝ in. steel tape of the CHESTERMAN type should cost more than $10.

Distances can be as readily measured whether the zero or far end of a steel tape be used or its front end. If the reel end be made the forward end, the objections many engineers have against using a reel attached tape will be overcome, whilst they will have the consolation of always knowing where the reel is when needed.

The advantages of having tapes graduated beyond the zero or other initial points is outweighed by the objections against such arrangement.

The assurances of the makers to the contrary notwithstanding, every tape, whether steel tape or band chain, should be cleaned thoroughly each time used. Slight rust can be readily removed by the application of coal oil and by rubbing it with waste. Emery paper should be used only in case of deep rust, for it wears away the graduation and body of the tape. Tapes should be slightly oiled when laid away or not in use.

It is only by the use of steel tapes that the science of fine line measurement is attainable. The great sources of fluctuation in fine, line tape measurements are due to three causes: 1st. Temperature; 2nd, tape strain; and 3rd, the greatest of all, to the methods of pin setting. To be accurately done, this last requires constant care and attention. Pins should be set under vertical plumb lines, and should measure the exact tape length from center to center. The second source may be eliminated by drawing the tape always under a constant pressure, and making due allowance therefor, determined from test of tape under a spring balance. The least is temperature. A change of 10° F. on a 100 ft. tape will affect its length only 0.006 ft., and owing to the great variety of substances and their varying powers of heat conducting, allowances for this source should be made only for considerable range of temperatures or for long line measurements.

In this latter day revival of stadia measurements, the mistake should not be made that such measurements are ever to be regarded as certain or reliable. They are only approximations of true quantities, and are useful only as such. The gradienter is far more preferable for this purpose; it is simpler in construction, more truthful in operation and reliable in results, while its cost is much less than that of the stadia attachments.

The admirable system of abreviated field notes used by the surveyors in this locality is unexcelled for rapidity of application, or for the amount of work that can be accomplished by it in a given space of time. Only 5 letters are required to do its work. Thus m = a fixed distance determined by measurement; md = a given distance laid off; ob = an angle determined by observation between fixed points; t = a given angle turned off and r = a repetition; as mr = a fixed distance measured twice with the same results, etc. These letters are used immediately after the figure affected by them, thus $421.95m$; $2307\ md$; $35° - 07'\ obr$, etc.

In 1882 Mr. C. H. BURGESS perfected a machine for repairing broken CHESTERMAN steel tapes. He used a capstan screw that punched three holes simultaneously. My improvement on this machine, shown above, consists in the removal of the capstan and the use of a guide block in its place, through which the punches are separately applied and the holes in the tape punched from a slight hammer blow. The objection to the capstan is, that when one punch is broken the other two are useless. It is also important that the three capstan punches should have exactly the same length or lead, a condition rarely ever realized. By the arrangement shown in Fig. 1 you can proceed with the punching when you have broken a punch, simply by getting another one. A few extra punches only are necessary to provide against such accidents.

The guide holes and dies should be exactly in line

The two fine vertical lines on the machine face are exactly $\frac{1}{10}$ ft. apart, either one being exactly $\frac{1}{10}$ ft. from the center of the 3 dies. The long slot also in the machine face is one-half the width of a steel tape. The clamp plate is operated by a thumb-screw in the front, and is hinged in the rear by a long screw passing through it and the guide block. The center of the tape space to be punched is placed exactly $\frac{1}{10}$ from one of the gauge lines, which is best done on a full tenth, or a 5-hundredth line. The tape is then clamped and the holes punched. The splice may be of any length. It should, to avoid error, be an even number of full tenths of a foot, nor should it ever be less than $\frac{1}{10}$ ft. Old tapes are used for splices. The tape ends are cut off with a pair of nippers, and in cutting them the nippers should be held a little above or below the tape alignment, so that the cut ends may be bent as shown exaggerated in Fig. 3, and that when riveted, as in Fig. 2, the laps will hug one another tightly, preventing their filling with dirt, or cutting your hand as it passes along. Die punches and rivets should be of one size. CHESTERMAN ⅝-in. web requires ¼-in. No. 20 brass escutcheon pins. Repairs should never be made with solder, or other soft hot metals, for reasons already given.

Every surveyor should have a conveniently located permanent base of government standard length, by which he should test his tape every time it is repaired. Such base should never be on a building floor, nor on substances affected by settlement, or such that temperature will affect the length of the base.

Ancient Wells.

Mr. BALDWIN LATHAM, says that as the art of well-sinking developed itself at an extremely early period, and long anterior to the commencement of history, no very great advance has been made in it; indeed, the mode usually adopted at the present day when sinking wells to a great depth in loose strata—by first forming a curb on which the ordinary steining is placed, and which settles down as the work of excavation is carried on within, and thereby preventing the loose soil falling into the well—was practised ages ago in sinking wells in the East, and from them we have copied the mode in more modern times. Wells of excellent construction abound in Hindostan, China, Japan, Tartary, Egypt, and elsewhere. When the British took possession of Hindostan, the number of wells in use in that country was estimated at 50,000. Many of the ancient wells were of great depth. The wells of Cabul are from 300 ft. to 350 ft. deep, and many of them are but 3 ft in diameter. The famous well at Tyre is said to be 630 fathoms in depth. JACOB'S well at Samaria is 105 ft. deep and 9 ft. diameter. The well Zem-Zem, at Mecca, is 210 ft. deep, and that of JACOB'S, at Cairo, 300 ft. deep.

The well of JOSEPH is a fine example of the skill and boldness of design of the well-sinker. Although called after JOSEPH by the Arabs, it is by no means of so ancient a date as the name would imply, for the well was probably sunk about seven hundred or eight hundred years ago, but by whom is a disputed point; some attributing it to a vizier of the name of JOSEPH, others to Saladin, the intrepid defender of his country, whose name was Yussef(JOSEPH). The well consists of two shafts, one above the other but not in the same vertical line. The upper shaft is an oblong excavation 24 ft. by 18 ft. and 165 ft. deep, descending into a large and capacious chamber, in the floor of which is constructed a basin or reservoir for containing water that is raised from the lower shaft. In this chamber a lower shaft is sunk, which is an excavation 15 ft. by 9 ft. and 130 ft. deep. Round the upper shaft a spiral passage 6 ft. 4 in. wide, and 7 ft. 2 in. high is cut, separated from the well by a partition wall of the solid rock, only 6 in. in thickness, through which loopholes are pierced for lighting the passage. This passage is made use of by parties who draw water, and also for the descent of mules or other animals that are employed in the large chamber below, to give motion to a system of chain pots by which the water is raised from the lower shaft and poured into the basin in the chamber. There is also a spiral passage round the lower shaft, but it is not enclosed from the well, as in the case of the passage round the upper shaft. The water of this well is procured from a bed of gravel, after penetrating the strata to the depth before mentioned Wells are common in Greece, and in the olden times of its classic glory were the places of public resort. Just as in modern times men congregate at their clubs and such like places, so did the sage Athenians meet together at their wells, and at them orators declaimed, and music and the dance lent their charm to make them places of pleasure and amusement.

Origin of the Letter X in Mathematics.

Government Engineer RITTER, in a note to *La Nature*, says:

"In writing the as yet unpublished biography of the immortal inventor of modern algebra, FRANCOIS VIETE, Maitre des Requêtes of the King's Palace, Counselor of State, and personal friend of HENRI IV., and in translating his mathematical works, I have necessarily had to extend my researches in algebra. I am, therefore, able to explain to your readers the origin of the letter x in equations. Ancient algebra, before FRANCOIS VIETE (*Aridmetika*, of Diophantus *Aljebr wâhmukâbalah* of the Arabs, *Ars magna* of Cardan, and *Ars rei* or *Ars cossica* of the Italians), was reduced to the solution of numerical equations. In Diophantus, the unknown (*aridmos*, 'number') is represented by the letter s with the numeral index (′). In the Arabian authors that I have been able to consult, the calculations are always written in all letters, and the unknown is designated by an Arabic word that has been translated as *res*, *cosa*, the 'thing.' And, says the learned Dr. NESSELMANN, the Arabs are so consistent in the application of this rhetorical method that they do not once employ a numeral sign in their texts. . . .

"FRANCOIS VIETE, in his introduction to arithmetic by symbols, substituted the literal for the numerical equation, and he thus succeeded in establishing modern algebra and in discovering the relations that exist between the given and the unknown in equations of different degrees. He represented the former by the capital consonants of the Latin alphabet (B, C, D, etc.), and the latter by the first small letters of the alphabet [*a*, *b*, *c*, etc.] Later on, Descartes changed this notation, and designated the known quantities by the first small letters of the alphabet [*a*, *b*, *c*, etc.], and the unknown by the last [*x*, *y*, *z*,]. . . . As in France, especially, the history of mathematics is not much known, it will certainly be for the first time that most of the readers of *La Nature* will read the name of one of the greatest geniuses that have rendered our country illustrious, and whose place is in the same rank with that assigned by posterity to Archimedes, Descartes, and Newton."

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

CONTINUED FROM PAGE 155.

Old Orchard, Me.—The works were commenced July 1, 1887, and on August 10 were reported about two-thirds completed; they were designed by B. R. CLARKE, and M. M. TIDD was Constructing Engineer, with STEPHEN CHILD as Assistant. The contractor for trenching and pipe laying was C. W. Talcott, of Woonsocket, R. I.; for pumping machinery, the George F. Blake Manufacturing Co., Boston, Mass.; for pipe, Donaldson Iron Co., Emaus, Pa.; for specials, Builders Iron Foundry, Providence, R. I.; for valves and hydrants, the Chapman Valve Manufacturing Co., Indian Orchard, Mass. The reservoir was constructed by Turner, Clarke & Rawson. The franchise is owned by Turner, Clarke & Rawson, of Boston, Mass., and the works are operated by the Old Orchard Water Co.; President, A. B. TURNER; Secretary, CLARENCE HALE. The franchise is for 20 years, and the hydrant rental is $40 per hydrant per annum. The estimated summer population is about 4,000.

Asheville, N. C.—The works were commenced in February, 1886, and are nearly completed, but have not yet been accepted; they were designed by ERNEST W. BOWDITCH, of Boston, and ED. D. BOLTON, of Boston, was Constructing Engineer. The contractors for masonry and foundations were Murdock & Colvin, of Asheville; for pumping machinery, Gordon, Maxwell & Co., of Hamilton, O.; for pipe and specials, the Chattanooga Pipe Works, of Chattanooga, Tenn.; for trenching and pipe-laying, Cole & Gillett, of Norfolk, Va.; for valves and hydrants, the Ludlow Valve Co., of Troy, N. Y.; for the standpipe, Alfred Webb & Co., Chattanooga, Tenn. The stand-pipe is 60 ft. high, and the top is 2,300 ft. above tide water. The price paid for trenching and pipe-laying was 16½ cts. per ft. The works are owned and operated by the city; Dr. D. T. MILLARD is Superintendent. The present population is estimated at 8,000.

(TO BE CONTINUED.)

[NOTE.—We beg to call attention to the fact that we have a special blank prepared, to be filled in by engineers, superintendents or other officials, from which these "Statistics of New Water-Works Construction" are compiled, and these blanks we are sending out to such officials connected with new works. We regret to say, however that we receive very few applications for these blanks, and of those which we send out, a comparatively small number are returned with the required information filled in. It is to the advantage of the parties interested, as well as for the benefit of our readers, that these details should be published, and we would request a more encouraging co-operation in this matter. All applications for blanks will be cheerfully and promptly attended to, and we shall be glad of any information as to newly finished works, so that we may extend the scope of our "Statistics" as widely as possible. Every reader should be interested in making this department of ENGINEERING NEWS as complete as possible.—ED.]

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

CONSTRUCTION NEWS.

Water.

Whitewater, Wis.—The Mayor, Mr. E. ENGEBETSON, has issued a message in which he states that the question of establishing a water supply has been agitated for some time, and that there is a very general opinion in favor of water-works. Work cannot be commenced before next spring and the Council will need the intervening time to thoroughly investigate the subject. He favors the stand-pipe system and the annual rental plan. The message concludes: "The principal items which will determine the cost per annum to city for public use are, 1st, the source of water supply, 2nd the number of miles of mains, 3rd the prospects for private consumption. The first of these, the water supply, will in our case be the most difficult to determine, whether it shall come from some of the many springs in the vicinity, from running streams emptying into the ponds, from a series of large wells or from an artesian well. If we could get sufficient flow of water from an artesian well it would be the most desirable. I would recommend that the council appoint a committee to thoroughly investigate this water works question and ascertain whether the citizens want water works or not, and if so, to determine where we shall get the supply, the number of miles of mains required and system and plan of operation, etc. You could then make plans and specifications for what the city would need, authorize receiving of bids for the same and make a contract with lowest responsible bidder." No official action has yet been taken, but the Council will probably do something with it in the course of a few weeks. The water-works will not be owned by the city, but by the contractors, and operated on the annual rental plan. Communications from contractors are now in order and may be addressed to Mr. HOW. S. SALISBURY, City Clerk.

New Water Works.—*Maine.*—Presque Isle. The water-works are nearly completed.—Old Orchard. Water has been turned on by the new works.—Bath. Work is progressing rapidly, and the works are to be completed and water turned on September 15. From 150 to 250 men have been constantly employed since the commencement, October 12, 1886, and 15 miles of pipe are laid. Five steam drills have been in use since the spring. F. B. DUAFEY is the contractor.

Massachusetts.—Canton. Water-works are to be established. F. M. AMES, of Boston, is interested.

Connecticut.—Portland. A system of water-works is in contemplation.

New York.—Chatham. The new works are a complete success and give great satisfaction.—Phœnix. The vote on the water question resulted in 136 in favor, and 12 against.—Antwerp. Water-works are to be established.—Sanford. A company has been formed to furnish a water supply. The water will be pumped from a spring to a reservoir and thence piped to the village.

New Jersey.—Montclair. Work is progressing and water may be turned on by October 1. It has been difficult for the contractors to secure all the laborers that might have been put on the work, but there are now 18 miles of mains laid out of the total of 22 miles. The well from which the supply of water is to be drawn for the present, has been sunk to the depth of about 90 ft., leaving 25 ft. yet to be dug. A double force of men are

now at work upon it. Worthington engines will be erected, and water will be supplied by direct pressure until the reservoir, to be located upon the mountain, can be completed.

Virginia.—Marion. The city has voted to build water-works; the supply will be brought from a spring 2 miles distant through a 6 in. pipe.

West Virginia.—Clarksburg. A vote will be taken on the proposed issue of bonds for the erection of water-works. The water will be pumped into a reservoir with a capacity of 1,000,0 0, galls., the reservoir being at a sufficient elevation to give a fire pressure.

Tennessee.—Bristol. A proposition to build works has been made by W. G. McDOWELL.—Johnson City. Two companies have applied for a franchise for water-works.

South Carolina.—Yorkville. Water-works are contemplated and a proposition has already been made to the city.

Florida.—Orlando. Water-works have been put in at a cost of about $70,000. The city has contracted to take 75 plugs, and the people are adopting this supply instead of depending upon wells.

Ohio.—Marion. About 200 men are now at work laying the water pipes.

Illinois.—Joliet. Water-works are to be contracted for about October 1. The works are to be completed in 12 months, and will be owned by the city.—Vandalia. A syndicate has made a proposition to put in water-works, agreeing to construct the works and supply the city for $6,000 per annum. The proposition will probably be accepted.

Michigan.—Lowell. Water-works are to be constructed.—Coldwater. The issue of bonds for $60,000 for water-works will be voted on September 6.

Minnesota.—Cannon Falls. The reservoir for the new works will be on the top of L mekiln bluff, and there will be 1,500 f. of mains to the village.

Iowa.—Carson. The city has voted to issue bonds for $200,000 for water-works, but no proposals within that amount have yet been received.—Dunlap. Water-works are being put in at a cost of $10,000.

Wisconsin.—Hudson. Pipe is being laid for the new works. The well struck water at a depth of 200 ft., but is being drilled deeper.—The works at Janesville, Portage, Steven's Point and Waukesha are expected to be completed this fall.

Kansas.—Water-works will be put in at Ness City and Nickerson.

Idaho.—Lewiston. A company is being organized to put in a water supply for domestic use, fire purposes and irrigation.

Nebraska.—Riverton. The city has voted to issue bonds for water-works.—Wymore. A franchise for water-works has been granted to a company.

Colorado.—Auburn. Water-works are proposed.—Highland. The people are satisfied with the quality and quantity of the water furnished by the Beaver Brook Water Co.

Texas.—Waco. The new works to be built with the $150,000 issue of bonds will be built by the city.—Temple. The water committee has reported that the artesian well project is inadvisable, and recommends a supply from the Leon river, 6 miles distant. The pipe laying and pumping plant for this work will cost $15,000 to $20,000.—Weatherford. The works will be built by a local company.—Greenville. Kelley & Co., the contractors, will commence work at once.

Bad Water Supply.—Atlanta, Ga. The water in several wells has been declared impure by the Board of Health, after analyses had been made.—Long Branch, N. J. The water supply is reported to be dangerously impure; the water being drawn from the cedar swamps 15 miles west from the shore, which swamps receive the drainage of a valley on whose sides are a number of residences, farms, stables, etc. The heavy rains of this summer are held responsible. The water is of bad color and odor, and is pumped through the mains without being filtered. Some sickness has been caused, and the water company has been urged to put in a filter.

Williamsport, Pa.—The work for the new supplementary water supply is being pushed forward rapidly. The new line of 16-in. main from the old line at Third and Rose streets, to the pumping station at the Reading Railroad bridge over Lycoming creek, is almost completed. The work has been very tedious on account of encountering a stream of water and quicksand at a uniform level of from 3 to 4 ft. below the surface of the light alluvial soil, which became so troublesome as to require sheet-piling at nearly every joint through the meadows west of Rose street; and even with this protection, the walls of the trench would slide in, until a width of 7 or 8 ft. became the regular thing. The pump house is completed, and a Knowles pump of 3,000,000 galls. daily capacity, is now being set up. The well is being excavated, and has already attained a depth of 30 ft., and will be sunk as much deeper as circumstances will warrant; it is 30 ft. diameter. A steam centrifugal pump is used to keep the excavation dry. The first 6 ft. passes through a light sandy loam, then 3 ft. of loose gravel, then thin veins of yellow and black iron hardpan, in a veiny net work, enclosing bodies of cobble stones and loose gravel stained by the soluble salts of iron, green, red, gray, etc. About 12 ft. below the surface the first water veins are met with, some of them being very strong, and it is a curious fact that the water coming from the south or river side has a temperature of 56 degrees, while that coming from the other side has a temperature of 70 degrees. From this depth downward large bowlders of quartzite, conglomerate and clay slate are encountered, the former secured almost round and quite smooth, as though brought from a great distance, while the slate is less worn, and seems as though it might have been wrested from the hills along Lycoming creek and slid over the edge of the gravel bar that was at that time making out into the river basin. Superintendent MCMINN is now working on the fourth mile of main pipe laid during the present season, and expects to have the new pumping station connected up and ready to start within two weeks.

Grand Rapids, Mich.—The Board of Public Works has submitted its report for the year ending April 30, 1887, being the 14th annual report. The total receipts from water for the year aggregated $32,677.25, a decrease of $470.99 over the previous year; This decrease is attributed to monthly instead of quarterly readings of the meters, as heretofore, wastage and leaks being thus brought more promptly to the attention of the consumer. During the year about 128,000,000 galls. were pumped in excess of the amount pumped in the previous year, and as only 90 new services were added, it is stated that the excess has to a large extent been wasted, which waste is largely attributed to leaky wood pipe. There are 385 meters in use. The distribution system comprises 27.6 miles of mains, 290 hydrants and 187 valves. The total number of gallons pumped was 874,774,000. The following work is reported by the City Surveyor: streets graded and paved, 3,815 ft.; graded, graveled and gutters paved, 33,634 ft.; graded and graveled, 9,167 ft; graded, 941 ft.; regraded and paved or graveled, 5,095 ft.; Medina sandstone curbing, 15,498 ft.; total cost of improvements, $112,230. The sewerage system was extended by 11,545 ft. of tile and 3,526 ft. of brick sewers, 30 manholes, 6 lamp-holes and 13 catch-basins; the sewer work was almost entirely lateral work; total cost of work, $17,640. The Pearl street bridge and Sixth and Newberry street bridge, built by the Massillon Bridge Co., Massillon, O., were completed, and a contract was let in June to the Wrought Iron Bridge Co., Canton, O., for a canal bridge consisting of plate girders, 48 ft. span. A new 16-in. main was laid across the river to replace a leaky 12-in. main; the work was done by W. R. COATS, of Kalamazoo, Mich. Work is progressing slowly on the new city hall. The city has 140.98 miles of streets, 91.04 on the east and 49.94 on the west side of the river; graded and paved with wood and stone, 6.614 miles; graded and paved with wood, .188; graded and paved with stone, 1.178; graded, graveled and gutters paved, 41.577; graded and graveled, 32.195; graded, 3.878; unimproved, 55.35 miles. The sewerage system comprises 16.921 miles of brick sewers; 20.09 of glazed pipe; .48 of cement pipe; 1.853 of wood and .16 mile of iron pipe sewer in the river; total, 39.504 miles. The following is a list of the cost of improvements: streets and alleys, $112,230; sewerage, $17,640; bridges, approaches, etc., $52,819.10; water mains, etc., $17,356.56; reservoir in Lincoln street, $174.90; total, $200,220.56. GEORGE W. THAYER is President of the Board and H. A. COLLAR is City Surveyor.

Sewerage.—*Southbridge, Mass.*—A complete survey of the town has been made for the Sewer Committee by A. C. MOORE, C. E., of Sturbridge, Mass., and a part separate system of sewerage has been recommended at an estimated cost of $11,500. The Chairman is W. C. BARNS; Secretary, G. G. BULLFINCH, M. D.

Athol, Mass.—At a recent town meeting a resolution was adopted to begin the construction of some system of sewerage at once and to expend a sum not exceeding $10,000 the first year.

Ware, Mass.—Engineer DAVIS, of Northampton, has forwarded his plans for a sewerage system to the State Board of Health.

Newport, R. I.—A proposition to expend $33,000 for sewer improvements will be voted on at the city election this month.

Harrison N. J.—The defective sewerage system has caused considerable trouble and propositions are now being considered for a thorough and complete system

Englewood, N. J.—The Sewerage Co. will put in a system of sewers as rapidly as possible. President HERBERT B. TURNER; Secretary, OLIVER D. SMITH.

Montgomery, Ala.—At a recent meeting of the City Council a resolution was adopted instructing the sanitary committee to employ assistants to help City Engineer WILLIAMSON in the survey and preparation of the plans for the proposed system of sewerage.

Springfield, O.—The City Council has adopted a resolution employing Col. GEO. E. WARING, C. E., of Newport, R. I., to make a preliminary examination of the conditions and report upon a sewerage system.

Galesburg, Ill.—The city has been enjoined from discharging sewage into Cedar Fork creek. This stream passes through the center of the city, and five sewers discharge into it. A new channel for the creek is being dug and the old one will be filled up. What will be done with the sewage is not known.

Salina, Kan.—Mr. ROBERT MCMATH, C. E., of St. Louis, Mo., has been in the city by invitation of the Council, to take into consideration a general system of sewerage. The plans are not yet completed, but Mr. MCMATH is at work on them.

El Paso, Tex.—Work has been commenced on the Waring system of sewerage under the supervision of Mr. FARQUHAR. The main sewer is on Second street, parallel with the Rio Grande, into which all the upper part of the city can be drained by gravity. The sewage will be pumped from Second street into the river.

Winston, N. C.—The surveys and plans for a joint system of sewerage for Winston and Salem have been completed by J. L. LUDLOW, of Winston, who will have charge of the work for the town as Chief Engineer to the sewerage committee.

Pensacola, Fla.—Arrangements have been decided upon for a system of sewerage. The plans will be submitted in October, and the work will be pushed during the winter.

Brockton, Mass.—The mayor has sent a communication to the Board of Aldermen urging prompt consideration of the proposed plans and decision as to the method of disposal, and also consideration of the method of assessment for the construction of the drains.

Proposals Open.

Bridges.—Over Shenandoah river at Riverton, Va. M. L. GARRISON, Front Royal, Va.

City Work.—Street paving and grading, stone drains, cleaning sewers, bridge repairs, macadamizing, asphalt paving, etc. LOUIS WAGNER, Director, Department of Public Works, Philadelphia, Pa. September 5.

Road.—About 110 rods. Plans and specifications with JOHN HOBSON, THE BOARD OF SELECTMEN, Ludlow, Mass. September 5.

Pipe Laying.—Laying 24-in. cast-iron water pipe, setting gates, plugs, etc. JAMES BROWN, Comptroller, Allegheny, Pa. September 5.

Sea Wall.—Rebuilding the sea wall on Roxbury canal. Plans and specifications at the office of the City Engineer. WM. B. SMART, Chairman of the Water Board, Boston, Mass. September 6.

Water Works.—THE CITY CLERK, Greenleaf, Kan. September 6.

Floors.—At Bellevue Hospital. THE DEPARTMENT OF PUBLIC CHARITIES & CORRECTION, 66 Third avenue New York City. September 6.

City Work.—Street improvement, sewers, plank walks, etc. THOS. J. NEVILLE, Clerk, Executive Board, Rochester, N. Y. September 6.

Sewers.—Main and branch sewers. LOUIS WAGNER, Director, Department of Public Works, Philadelphia, Pa. September 6.

Sea Wall.—At East River park between 84th and 86th streets. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. September 7.

Dredging.—In Raritan river, N. J. Lieut. GEO. MCC. DERBY, U. S. Engineer Office, Greene and Houston streets, New York City. September 7.

Removing Pier.—Burned pier No. 37, North river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. September 8.

Jetty.—Brush and stone jetty at Barnegat light station, N. J. Major D. P. HEAP, U. S. Lighthouse Engineer (3rd and 4th Districts), Tompkinsville, N. Y. September 10.

Steam Heating Apparatus.—At the Infantry School and the Custom House, London, Ont. A. GOBEIL, secretary, Department of Public Works, Ottawa, Canada. September 12.

County Court House.—Plans and specifications at the office of C. WHEELOCK & SON, Birmingham. Judge M. T. PORTER, Birmingham, Ala. September 12.

Sewer and Plumbing Work.—Renewal and repairs to sewer connections and plumbing at the Insane Asylum, Ward's Island. THE DEPARTMENT OF PUBLIC CHARITIES AND CORRECTION, 66 Third avenue, New York City. September 13.

Sewers.—PERCIVAL W. ST. GEORGE, City Surveyor, Montreal, Canada. September 14.

Sewer.—WALTER P. RICE, City Engineer, Cleveland, O. September 15.

Iron Work.—For new armory. THE ARMORY BOARD, *Staats Zeitung* Building, New York City. September 16.

Surveying.—Township surveys. Surveyor General HAMMOND, San Francisco, Cal. September 19.

City Work.—Pipe drain of 12 in. sewer pipe; street grading, paving, etc. THOS. J. LANAHAN, Clerk, Board of Contract and Apportionment, Albany, N. Y. September 19.

Bridge.—Lake street and Marshall avenue bridge; masonry substructure and iron superstructure, separate bids. Plans and specifications at the office of J. S. SEWALL, Engineer, Gilfillan block, St. Paul, Minn. L. A. CONDIT, Secretary, County Auditor's office, Minneapolis, Minn. September 20.

Engine Repairs.—Overhauling and repairing two Worthington 5,000,000 galls. pumping engines. H. C. COTTER, Superintendent of the Water-Works, Toledo, O. September 20.

Street Work.—WALTER P. RICE, City Engineer, Cleveland, O. September 22.

Bridge.—Wagon bridge across the Niobrara river at Fort Niobrara, Neb., in accordance with plans and specifications on file. Also for bridge in accordance with plans submitted by bidders, one span or two spans with stone pier on iron cylinders. Lieut. J. W. SUMMERHAYES, Quartermaster, U. S. A., Omaha, Neb. September 23.

Dredging.—In Pocomoke river, Md. WM. F. SMITH U. S. Engineer Office, Wilmington, Del. September 26.

Contracting.

Depot.—The contract for the construction of a passenger and freight depot at Lonaconing, Md., for the Cumberland & Pennsylvania R. R., has been awarded to E. J. Fredlock, of Piedmont, W. Va.

Water Tower.—Proposals for the construction of a brick water tower were opened yesterday by the President and Trustees of the town of Pittsfield, Ill.

Steamers.—The Globe Iron Works, Cleveland, O. have the contract for six steel steamboats for the St. Paul, Minneapolis & Manitoba R. R. Co., to run between Duluth, Minn., and Buffalo, N. Y. They will cost about $220,000 each.

Stone Work.—The following proposals have been received for the stone work of the public building at Augusta, Me: Hallowell Granite Co., Hallowell, $72,997; Maine & New Hampshire Granite Co., Portland, $74,790; Horace Purinton & Co., Waterville, $74,875; Mount Waldo Granite Co., Frankfort, $79,000.

The Alabama Construction Co. has been incorporated at Birmingham, Ala., by W. H. MORRIS, ROBERT JAMISON, B. F. RODEN and others, with a capital stock of $50,000. The company will undertake the construction of railroads, canals, etc., and will purchase and improve property.

Masonry.—The following were the proposals received by the Docks Commissioners, New York City, under the second advertisement for granite work and masonry on the boat landing wall and about the approach to Pier "A," North river: Joseph Moore, $9,000; John J. Conners, $9,600; Bernard Mahon, $17,750. All the bids were rejected.

Removing Ledge.—The following proposals for removing Babson's Ledge, in Gloucester harbor, Mass., were opened Aug. 30 by Lieut. Col. G. L. GILLESPIE, U. S. Engineer Office, Boston, Mass.: W. D. Duncan & Nickerson, Boston, $14.75 per cu. yd.; Thomas Symonds, Leominster, Mass., $21; Chas. H. Edwards, Quincy, Mass., $30.

Canal Locks.—The following proposals for enlarging locks Nos. 8 and 48 on the Black River canal were opened Aug. 23 by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.: Thos. H. Stryker, Rome, N. Y., lock 8, $12,158.50; lock 48, $11,508.50. James E. Flood, Sandy Hill, N. Y.; lock 8, $12,532.50; lock 48, $9,895.50. Philip McGuire, Forestport, N. Y.; lock 48, $12,69.80. The contract for lock No. 8 was awarded to hos. H. Stryker, and for lock No. 48 to Jas. E. Flood.

Water Pipe Box and Fender.—The following proposals for rebuilding the water pipe box and fender at Chester bridge, north, Boston, Mass., were opened by the Water Board, August 27; J. N. Hayes & Co., Boston, $14,500; McInis & Parker, Boston, $14,526.06.

Laying Water Mains.—The following contract was awarded by the Commissioner of Public Works, New York City, August 30: J. Cornwell, rock excavation, 24 cts. per cu. yd.; earth excavation, 24 cts. per cu. yd.; filling, 10 cts. per cu. yd.; 12-in. and 6-in. pipe, 50 and 25 cts. per lin. ft.; 12-in. and 6-in. stop cocks, $8 and $6; A and B hydrants, $6; paving, 20 cts. per sq. yd.; curbing, 2 cts. per lin. ft.; brick masonry, $1 per cu. yd.; total, $5,723.

Sewers.—*New York.*—The following contracts were awarded August 30 by the Commissioner of Public Works: In West street, with alterations to existing sewers; James Baird, sections A, B, C, D, E, F, $25.68, $18.85, $14.40, $17.95, $13.45, $10.45; brick masonry, $20; manholes, $400; timber, $17 per 1000 ft. B. M.; total, $26,462.45. In 53rd street; M. J. Slodon, sewer, $3.90 per ft.; pipe sewer, $3.30; rock excavation, $3.95 per cu. yd.; timber, $30; total, $9,311. In 9th avenue; P. Kearns, sewer, $3.70; rock excavation, $4; receiving basins, $175; pipe culvert, $1.75; timber, $25; total, $9,898.50. In 122nd street; J. Doran, pipe sewer, $3.05; total, $732.

Rochester, N. Y.—Contracts have been awarded as follows by the Executive Board: Post street pipe sewer, Walter E. Curtiss, roadway and sidewalk grading, 10 cts. per lin. ft.; 12-in. sewer pipe, $1.02 per lin. ft.; surface sewers, $15; Y and T branches, $3; laterals, $7.80; manholes, $40; total, $1,929.26. (Estimate, $2,080.)—Avenue D. Pipe sewer, N. L. Brayer; 12-in. sewer pipe, including grading, 93 cts. per lin. ft.; surface sewers, $17; Y branch, $1.50; laterals, $6.50; lamphole, $10; total, $550.60. (Estimate, $970.)—Lakeview tract outlet sewer; Geo. Chambers, 20-in. sewer pipe, including grading, $2.52; 18-in. ditto, $1.59; surface sewers, $20; Y branches, $2.65; manholes, $40; total, $3,235.08. (Estimate, $4,300.)

Philadelphia, Pa.—The following proposals have been received for the construction of the Manayunk intercepting sewer for a length of 2,315 ft.: James Sullivan, $32,695; James F. Kennedy, $32,900.20; R. A. Malone & Sons, $34,693.80; James Deehan, $35,168.50.

Levee Work.—The following proposals have been received by the Board of State Engineers at New Orleans, La.: Homestead Union, Iberville parish.—P. Harnan, 21¾ cts. per cu. yd; John B. McGinty, 21; P. J. Tyrell, 19¾; A. Gervin, 21; John Ryan, 15¾; A. Matta & Byrne, 17¾; R. M. White, 18¾; Ogden & Jones, 17 49-100; Robert McNamara, 19; Martin Head, 22. John Ryan's bid was recommended for acceptance.

Gem. Ascension parish.—P. Harnan, 22¾ cts. per cu. yd.: P. J. Tyrell, 22¾; R. M. White, 18 14-15; Ogden & Jones, 19 95-100; Robert McNamara, 19. White's bid was recommended for acceptance.

Delogny, St. James.—M. B. McGary & Co., 18 19-20 cts. per cu. yd.; P. J. Tyrell, 17¾; A. Matta & Byrne, 17; Morgan O'Connell, 18¾; Ogden & Jones, 17¾; Martin Head, 18¾; John Cleary, 16. Cleary's bid was recommended for acceptance.

Greenwood, Lafourche, Left Bank—P. Harnan, 29 cts. per cu. yd; G. Dionne, 24; Robert McNamara, 24¾. All bids rejected and levee to be re-advertised.

Lyall and Leblanc, Lafourche, Left Bank—S. Abraham & Bro., 18¾ cts. per cu. yd.; P. Harnan, 29; Robert McNamara, 24¾. Abraham's bid recommended for acceptance.

Knobloch, Lafourche, Left Bank—W. Herbert, 21¾ cts. per cu. yd: P. Harnan, 29: G. Dionne, 26; Robert McNamara, 23, Herbert's bid recommended for acceptance.

Pittmann, Lafourche, Left Bank—S. Abraham, & Bro., 18: P. Harnan, 30; Wm. Dowling, 24; G. Dionne, 38; Robt. McNamara, 24¾. Abraham's bid recommended for acceptance.

St. Pietus, Assumption, Left Bank—P. Harnan, 20; J. M. Herriard, 15¾; G. Dionne, 26; Robt. McNamara, 22; Martin Head, 19¾. Herriard's bid recommended for acceptance.

Aubert Herbert, Lafourche, Right Bank—P. Harnan, 33; G. Dionne, 25; Robt. McNamara, 24. All bids rejected and levee to be re-advertised.

Leighton, Lafourche, Right Bank—Robt. McNamara, 24. Bid rejected and levee to be re-advertised.

Blake, Lafourche, Right Bank—P. Harnan, 40; Robt. McNamara, 45; P. Rousseau, 29¾. Bids rejected and levee to be re-advertised.

Lafourche Crossing, Lafourche, Right Bank—P. Harnan, 29; Wm. Dowling, 22; Robt. McNamara, 26; Jas. P. Griffin, 30, Dowling's bid recommended for acceptance.

Belair, Plaquemines, Left Bank—M. B. McGary & Co., 21 4-9; John Dymond, 16 74-100; Robt. McNamara, 17½; Martin Head, 22. Dymond's bid recommended for acceptance.

Union, Plaquemines, Left Bank—M. B. McGary & Co., 21¾; L. Forsythe, 14 94-100; Robt. McNamara, 17½; Martin Head, 19. Forsythe's bid recommended for acceptance.

Guidroz, Lafourche, Right Bank—Robt. McNamara, 25. Bid rejected and levee to be readvertised. Proposals for work on other levees will be opened to day.

Assistant State Engineer BOLIVAR THOMPSON has returned from staking off the new line of the Diamond Island Bend levee. The completion of this levee is of great importance to Louisiana, and will be pushed ahead as rapidly as possible. Engineer THOMPSON said, relative to the construction of this levee, that it would close all the dangerous gaps along the Mississippi, and continued: "As the river falls there will surely and unavoidably be some caving in of the banks, which must necessitate new work. This will occur every year. But it is anticipated and provided against and all will be made secure before another high water. The only drawback fear is a scarcity of labor; but if we should be fortunate in securing good contractors, whose reputation for prompt payments is established, and who will employ the proper agencies in enlisting men, there should be a full supply from November to March next. Whites are decidedly superior to negroes. The estimate is that on an average two whites will accomplish as much as three negroes, except where scrapers are employed; then a darky beats all creation at driving the mule. Besides, if the negroes are taken for our work, their valuable services must be lost to the planters—so you see that would work badly all around. However, I feel confident that we have got the top of the great task after these many long years of struggle, and that hereafter this advantage will be maintained."

Surveys.—Surveyor-General Hammond, San Francisco, Cal., has issued a call for bids for the survey of one-half mile of township lines, fourteen and one-half miles of section lines, and two and one-half miles of meander lines. This work will complete the survey of public lands in Township 14 north, Range 1 east, in the Humboldt meridian. The contract will be let to the lowest bidder at rates not exceeding $7 for township lines, $5 for section lines, and $9 for meander lines. All tenders must be filed before the 18th of September.

Water-Works.—*Waterville, N. Y.*—The following proposals for the construction of water-works at Waterville, N. Y., were received by I. D. BRAINARD, President of the Water-Works Trustees: Sullivan & Stafford, Little Falls, N. Y., $50,699.57 for works complete, or $24,673.12 for work only; Sherman & McDonough, Utica, N. Y., $51,450 for works complete; Rider & Dougherty, Yonkers, N. Y., $55,566.81 for works complete; G. W. White, Pulaski, N. Y., $51,947.90 for works complete, or $22,754.30 for work only; Chambers & Casey, Rochester, N. Y., $28,777.30 for works excepting pipe and specials, or $26,442.10 for work only; Warren Foundry & Machine Co., Reading, Pa., $22,304.50 for pipe, $428.25 for specials; C. Millar & Son, Utica, N. Y., $22,745.96 for pipe, $418.76 for specials, $1,484.75 for hydrants, $648.55 for valves, and $100 for valve boxes; R. D. Wood & Co., Philadelphia, Pa., $24,049.35 for pipe, $438.31 for specials, $1,484.75 for hydrants, and $98.25 for valve boxes; Mellert Foundry & Machine Co., Reading, Pa., $25,393.80 for pipe, $381.37 for specials, $1,336 for hydrants and $668 for valves; Builders Iron Foundry, Providence, R. I., $400.25 for specials and $99 for valve boxes; Eddy Valve Co., Waterford, N. Y., $1,210 for hydrants, $611.40 for valves and $99 for valve boxes; Ludlow Valve Manufacturing Co., Troy, N. Y., $1,411 for hydrants, $668.10 for valves and $110.28 for valve boxes; Chapman Valve Manufacturing Co., Indian Orchard, Mass., $1,136 for hydrants and $656.41 for valves; Tamaqua Manufacturing Co., Tamaqua, Pa., $1,297 for hydrants; Coffin Valve Co., Boston, Mass., $556 for valves. The contract was awarded to G. W. White, of Pulaski, N. Y., at $22,754.30 for work only, the village to furnish pipe, hydrants and valves. Work will be commenced at once.

Coshocton, O.—At a regular session of the Council, August 24, the proposals for the erection of a system of water-works were opened, and by resolution the contract was awarded to the American Water-Works & Guarantee Co., of Muncie, Ind., subject to the approval of the citizens at a legal election. The proposition will carry by an almost unanimous vote. The people are much pleased at the prospect of a supply of water that is greatly needed.

Defiance, O.—The contract for the construction of the water-works has been awarded to S. R. Bullock & Co., of New York City.

Ocala, Fla.—The contract for the construction of a system of water-works has been awarded to W. A. Jeter at about $70,000.

Parkdale, Ont.—Not one bid was received in answer to the recent advertisement for proposals for the construction of water-works.

Bridge Contracts.—*Providence, R. I.*—The following proposals were received August 25, by J. A. LATHAM, C. E.: Elmwood avenue bridge over the Pawtuxet river; iron bridge, 140 ft. span, 20 ft. roadway, capacity 100 lbs. per sq. ft. in addition to weight of bridge; also for furnishing and driving 150 piles, and building two stone abutments, 202 cords each: Superstructure, Dean & Westbrook, New York, $6,025; R. F. Hawkins, Springfield, Mass., $6,200; Pittsburg Bridge Co., Pittsburg, Pa., $6,347; King Iron Bridge & Manufacturing Co., Cleveland, O., $6,450; Berlin Iron Bridge Co., Berlin, Conn.; $6,500; J. W. Shipman, $6,650. Substructure; J. A. Daley & Son, $3,546: Nash & Ingerson, $4,200; P. McMahon, $4,376; J. T. Lank, $4,780.

——Bridge at Arkwright, iron bridge, 127 ft. span, 18 ft. roadway, 100 lbs. capacity per sq. ft.; also for abutments and wing walls, 166 cords: Superstructure; Dean & Westbrook, New York, $4,250; J. W. Shipman, $4,450; R. F. Hawkins, Springfield, Mass, $4,550; Berlin Iron Bridge Co., Berlin, Conn., $4,700; Pittsburg Bridge Co., Pittsburg, Pa., $4,728; King Iron Bridge & Manufacturing Co., Cleveland, O., $4,925. Substructure; G. H. Graves, $830; P. McMahon, $913; O. McCusker, $913.

Decatur, Ala.—The Decatur Iron Bridge & Construction Co. has a contract for three iron bridges in Giles county.

Americus, Ga.—A. R. Coulter has the contract for a bridge and all the trestles on the new railroad from Abbeville to McRae.

Denver, Col.—Five bids were received for the Nineteenth Street bridge and substructure. The contract was awarded to the lowest bidder, the Missouri River Bridge & Iron Co., Leavenworth, Kan., for $25,850. The bridge is to be completed within 4 months from the date of the contract.

Marshall, Tex.—W. Woodson has the contract for the bridges along the branch of the St. Louis, Arkansas & Texas R. R., from Louisville, Ark., to Shreveport, La.

Quebec, Canada.—Alphonse Charlebois has the contract for the erection of the new iron bridge across the Chaudière.

Street Railroad.—The contract for the extension of the Covington Street Railway, Covington, Ky., has been awarded to Bruce Morton, of Newport, Ky.

Water-Works Bonds.—The bonds for $100,000 for the construction of the water-works at Bismarck, Dak., have been taken up by ERNEST MORRISON, of Baltimore, Md.

The Chalmers Spence Co., of New York, have just placed by Mr. T. K. MCKNIGHT, their Pittsburg agent, a contract with the Southern Cotton Oil Co. covering a quantity of their new "C" Asbestos Removable Covering sufficient to cover all the pipes, boilers, etc., of their extensive new mills.

Sault Ste. Marie Canal.—The Department of Railways and Canals, Ottawa, Canada, gives notice to contractors that tenders for the new Sault Ste. Marie canal will probably be called for in January next, and that from now to the middle of November is the best time for examining the locality.

Plumbing, Steam Heating, Etc.—The following proposals have been received for work at Public School No. 4, Buffalo, N. Y.: Plumbing and gas fitting; Barnd & Geiger, $611; Iribacker & Davis, $630; Mensch Bros., $647. Steam heating and ventilating: Iribacker & Davis, $6,109; C. K. Summerhays, $6,290; Barnd & Geiger, $6,341.

Armory.—The following were the lowest bids for the construction of the 8th Regiment armory, opened Aug. 25 by the Armory Board, New York City; mason work, Morgan & Armstrong, $144,443; iron work, Wallis Iron Works, $107,047; carpenter work, Thomas Overington, $54,900; plumbing work, John Renehan, $9,000; steam heating and ventilating, Baker, Smith & Co., $11,475. The iron work is readvertised, only one bid having been received.

Harbor Dredging and Dam Repairs.—Under the direction of the harbor committee of the City Council, Providence, R. I., the work of dredging around the several docks at the outlets of main sewers has been carried on since last June by Mr. Charles W. Anthony, of Fall River, and has been completed, the bills having been presented to the City Auditor for approval. The work aggregated 5,112 16 cu. yds. The cost of dredging has been 50 cts. per cu. yd. amounting to $2,556.08. The work was practically completed on July 30, and easy access is now afforded to heavy barges and sailing craft to the wharves. Some months ago the city council appropriated $950 for the repair of the dam at the outlet of the Cove basin, which had been partially carried away by the freshet in February, 1886. The work was allotted to the Providence Dry Dock & Marine Railway Co. and operations were begun in June last. Thus far bills have been allowed and ordered paid amounting to $668.37 and it is thought that the entire cost will reach $800. The dam is raised at a sufficient height to flood the basin at the depth of 2 ft. mean low water, and thus mitigate in some degree the noxious stench arising from the flats when exposed.

Fruit Hill Reservoir.—The following are the contract prices for work on the Fruit Hill reservoir for the water-works at Providence, R. I., the contract for which has been awarded to James J. Newman, of Providence: earth excavation, including boulders of less than 1 cu. yd., for the embankment, including grubbing, clearing, grading, rolling, etc., 47 cts. per cu. yd.; rock excavation and boulders over 1 cu. yd., $1.50 per cu. yd.; coal-tar concrete, in place, $5.54 per sq. yd.; concrete masonry, in place, $5.88 per cu. yd.; broken stone, in place, $1.90 per cu. yd.; laying slope wall, $3.80 per sq. yd.; rubble masonry, in place, $5.75 per cu. yd.; dimension, quarry faced granite masonry, in place, $35.50 per cu. yd.; dimension granite dressed masonry (embankment steps), in place, $60 per cu. yd.; Danvers pressed brick masonry, in place, $24 per cu. yd.; ordinary brick masonry, in place, $14 per cu. yd.; building gate house, $1,980; erecting bridge to gate house, including materials (excepting bridge), $35; setting all pipes, special castings and gates for same, including materials, except pipes, specials and gates, $375; 30-in. conduit from gate chamber to center of reservoir, $3.65 per lin. ft.; drain culvert, $2.35 per lin. ft.; placing soil on outside slope and top of embankment, including rolling, 40 cts. per cu. yd.; furnishing and laying sod on embankment, 35 cts. per sq. yd.; ploughing, harrowing, clearing and rolling bottom of reservoir, 5 cts. per sq. yd.; broken stone foundation of coal-tar concrete walk, in place, including materials, $1.90 per cu. yd.; for all extra work done, its reasonable cost, plus 10 per cent. of said cost. Work to be commenced within 25 days from the date of the contract (August 9) and completed by January 1, 1889. The contractor will be allowed $20 per day for each day between the completion of the work and January 1, 1889.

The reservoir will be of rectangular form, about 650 ft. long, 475 ft. wide and 24 ft. deep. The following are the approximate quantities: earth excavation, 90,934 cu. yds.; rock excavation, 500 cu. yds.; coal-tar concrete, 618 cu. yds.; concrete, 3,750 cu. yds.; broken stone for embankment slope, 2,005 cu. yds.; stone slope wall, 9,279 sq. yds.; rubble masonry, 261 cu. yds.; dimension quarry-faced granite masonry, 109 cu. yds.; dimension granite dressed masonry (embankment steps), 12 cu. yds.; Danvers pressed brick masonry, 78 cu. yds.; ordinary brick masonry, 24 cu. yds.; 30-in. brick conduit, 250 lin. ft.; 20-in. brick drain culvert, 330 lin. ft.; soil on embankment, 3,281 cu. yds.; sodding, 9,895 sq. yds.; preparing bottom for concrete, 15,160 sq. yds.; broken stone foundation for coal-tar concrete walk, 412 cu. yds. The plans and specifications were prepared by SAMUEL M. GRAY, City Engineer.

Railroad Contracts.—*Chicago & Northwestern R. R.*—The contract for the construction of the extension from Ishpeming to Republic, Mich., with a branch to Michigamme, has been awarded to Langdon & Co., of Minneapolis, Minn. The survey is nearly completed and a very large force of men will be put to work immediately. The extension traverses the richest mineral belt of Northern Michigan. Langdon & Co. will complete the line of the Minneapolis, Sault Ste. Marie & Atlantic R. R. from Minneapolis to Manistique, Mich., this season.

Clinch Valley R. R.—Contracts have been awarded as follows: McGrann & Stewart, Lancaster, Pa., 25 miles; Geo. T. Mills, Philadelphia, Pa., 25 miles; John Sexton and G. O. Houston, Roanoke, Va., 5 miles.

Lynchburg & Durham R. R.—The contract for the first 10 miles has been awarded to J. R. Serpell & Co., of Louisville, Ky.

Chicago, Cincinnati & Charleston R. R.—The contract for 102 miles of tracklaying between Blacks and Camden, S. C., has been awarded to Taylor & Elmer, of New York. Work has been commenced and is to be completed by January. The line will be located through Johnson City, Tenn., this month, and construction will begin in October.

Mobile & Birmingham R. R.—G. Copenning, of Birmingham, Ala., has a contract for the construction of 60 miles of road.

Mobile & Dauphin Island R. R.—Contracts have been awarded as follows: Lathrop & Smith, 4 miles; Taylor & Watson, 2¼ miles; M. Richardson, 2 miles. The contracts for grading 5 miles and for laying the track from Mobile, Ala., to Cedar Point, have been awarded to W. W. Ansley & Co., of Birmingham, Ala.

Birmingham Mineral R. R.—Worthington & De Bardeleben, of Birmingham, Ala., have the contract for the construction of 14 miles.

Philadelphia & Reading R. R.—The contract for grading the extension from Glassboro to Mullica Hill has been awarded to Frank Thomas, of Shippensburg, Pa., and work is to be commenced at once. The road will cost $85,000.

Oxford & Clarksville R. R.—The contract for the construction of this Southern road has been awarded to the New York & Southern Construction Co., of Richmond, Va.

Chattanooga, Rome & Columbus R. R.—The contract for building 14 miles of the road was awarded, August 18, to T. B. Redmond, of Rome, Ga. The contract begins just south of the six mile section being built by S. S. Eaton. It is hoped to have the line completed and in operation from Chattanooga to Rome by next summer, and to have the entire road completed to Columbus by June, 1889.

Mexican National Ry.—The contract for the construction of 114 miles between San Miguel de Allende and San Luis Potosi, has been awarded to J. H. Simpson and William Garland. The work is to be completed within a year.

E. B. Popejoy, of Birmingham, Ala., has a contract to build 50 miles of road in Arkansas.

Fulton, Michelson & Scott, of Brunswick, Ga., have a contract for 12 miles of road in Georgia.

RAILROADS.

East of Chicago.

Existing Roads.—*Bloomsburgh & Sullivan.*—On this Pennsylvania line track is laid to near Benton, 19 miles, and men are at work ballasting, lining and surfacing. The contract has been let for 8 miles farther to Central, and the track is expected to reach Central by December. JOHN A. WILSON is Chief Engineer and U. S. LUTZ, Principal Assistant.

Chicago & Northwestern.—The extension from Iron River to Watersmeet, Mich., 35 miles, has been completed and opened for business. The surveyors are at work on the proposed extension from Ishpeming to Champion.

Lehigh & Lackawanna.—Work is in progress on an extension of this Pennsylvania road from Wind Gap to Stroudsburg, 40 miles. The line is controlled by the Lehigh Coal & Navigation Co. At Stroudsburg connection is made with the Delaware, Lackawanna & Western.

Chicago & Eastern Illinois.—Work has begun on the extension from Momence, Ill., to Goodland, Ind., on the Chicago & Indiana Coal road.

New Castle & Northern.—Grading is nearly completed on this short Pennsylvania road running from New Castle to Middlesex. The line is to be operated by the Erie.

Lake Shore & Michigan Southern.—The Shenango Valley line, which this company has been building to Sharon, Pa., has been obstructed by the Nypano in its construction work. Recently a force of hands was mustered at midnight and put the tracks down through the disputed territory before daylight. From this point the line will be built to Sharpsville.

Scioto Valley.—This road recently effected a similar piece of work to the above in the city of Portsmouth, O. Right of way had been secured from all the property holdors but one, who threatened legal obstructions. A force of trackmen were mustered at sunrise and by nine o'clock the half mile of track was laid ready for trains.

Midland of Indiana.—On the western extension the track is laid to New Ross, where the line crosses the Indiana, Bloomington & Western.

Sebasticook & Moosehead Lake.—F. E. MCINTOSH has been appointed Superintendent of this Maine road, and it is thought work will be undertaken soon on the extension to Wellington.

Baltimore & Ohio.—Right of way is nearly obtained for the extension of the Fayette County railroad from Uniontown, Pa., southwest to a connection with the Fairmount, Morgantown & Pittsburg road, and the locating survey will begin at once.

New Projects and Surveys.—*Toledo, Saginaw and Mackinaw.*—This Michigan line, whose total projected length, as indicated by its title is about 250 miles, is now being located from Durand to East Saginaw, about 40 miles, and right of way is being secured. It is expected to let contracts this month. P. H. KETCHAM, East Saginaw, is Vice President.

Detroit & St. Clair River.—About 15 miles of right of way have been secured for this proposed Michigan line. FRANK L. DODGE of Lansing is interested.

New York & Boston Rapid Transit.—The New York Park Commissioners have passed an ordinance prohibiting this company from using any part of the public parks for an elevated road in the furtherance of their plans for an entrance to New York City. The managers of the company say that this will not materially affect their project. The whole line is to be under contract by November, and each contractor is to give bonds for the completion of his work within ten months.

Vincennes & New Albany.—This Indiana project still "hangs fire," but it is stated that grading will begin during the present month.

Marion & Indianapolis.—This Indiana line, which was projected and put well on the way to construction six years ago, is being revived, and much interest is exhibited in its construction. The line is to run from Marion *via* Independence and Noblesville to Indianapolis. The line is projected to give the Toledo, St. Louis & Kansas City road an entrance to Indianapolis. DAVID OVERMAN, Marion, Ind., is President.

Quebec Montmorenci & Charlevoix.—It is stated that work is to begin very soon on this proposed Canadian line.

Southern.

Existing Roads.—*Charleston, Cincinnati & Chicago.*—This company now has 95 miles in operation, 45 miles between Blacks and Rutherfordton, N. C., and 50 miles from Ashland to Richardson, Ky., the old Chattaroi railroad purchased last spring. Lines are now under construction, from Camden, S. C. to Black's S. C., 102 miles; from Augusta, Ga., to Newberry, S. C., 71 miles; and from Richardson, Ky., ten miles south. Lines are under survey from Newberry to a point on the main line in York county S. C., 80 miles, *via* Union, S. C.; from Rutherfordton to Richardson, Ky., 208 miles, *via* Marion, N. C., Johnson City, Tenn., Estillville, Va., and Pikeville, Ky. Of these lines the portion between Rutherfordton and Marion, 25 miles, and between Johnson City, Tenn., and the Virginia coal fields, 57 miles, will be put under contract at an early date. The most important bridge on the line is at the crossing of the Catawba river, 525 ft. in length, and is now under construction. A tunnel near the North Carolina and Tennessee boundary will be 3,100 ft. in length. SMITH & RIPLEY, chief contractors, are pushing the work, and will finish the tracklaying between Camden and Black's by January 1st. THOS. E. MATSON, Rock Hill, S. C., is Chief Engineer.

Illinois Central.—The survey of the line from Jackson, Tenn., to Memphis, 90 miles, is about completed, and the surveying party will now run a line from Memphis north to Cairo, about 200 miles, following the Mississippi valley as far as practicable.——The company has applied to the City of New Orleans for wharf privileges along half a mile of the water front.

West Virginia Central & Pittsburg.—About 500 hands are grading on the southwest extension.

Georgia Southern & Florida.—Grading is making good progress on this Georgia road.——The directors have given notice of intention to build a branch from Valdosta to Dublin.

Chattanooga Rome & Columbus.—The first 20 miles of this road, from Chattanooga south, are under construction.

Buena Vista & Ellaville.—The extension of this line to Americus, Ga., is making rapid progress, and with its completion the extension to Columbus will probably be undertaken. EDWIN F. JONES has taken the place of Chief Engineer PAYNE on account of the latter's illness.

Americus, Preston & Lumpkin.—Grading is completed to Abbeville, 60 miles east of Americus, and track is laid within five miles of that point. Contracts have been let to A. R. COULTER for the bridge over the Ocmulgee at this point, and surveys are being made to the line of the East Tennessee, Virginia & Georgia at McRae and McVille.

East Tennessee Virginia & Georgia.—It is stated that this company intends to begin work soon on from two to three hundred miles of extensions. A line is to run from Knoxville *via* Emory Gap to Nashville, 150 miles. Another from Clinton, Tenn., to Cumberland Gap, 60 miles. And a third from Emory Gap to South Pittsburg, Tenn., *via* the Sequahatchie Valley.

Kansas City, Memphis & Birmingham.—On the bridge across the Tombigbee river at Aberdeen, Miss., the excavation for the pier foundations has reached bed rock. Work will begin soon on the depot at Aberdeen.

Louisville & Nashville.—Tracklaying is in progress on the Huntsville, (Ala.) branch known as the Birmingham Mineral road, and it is expected to have the line ready for traffic by Oct. 1.

Augusta & Chattanooga.—EUGENE VERDERY, of Augusta is to be President of the construction company which will build this line. The final location is in progress through Pickens county, S. C.

New Projects and Surveys.—*Powell's Valley*—This Tennessee line has been surveyed from Knoxville to Cumberland Gap, 65 miles, contracts will be let Sept. 15, the work to be finished by Aug. 15, 1888. There are to be two iron bridges on the line and one 4,000-ft. tunnel. This road is backed by the American Association, Limited, of London, Eng. ALEX. A. ARTHUR, of Knoxville, Tenn., is President of the railroad company, and J. W. WILSON is Chief Engineer. A branch is also proposed, extending from the Clinch river, *via* Rutledge and Morristown, to a connection with the extension of the Carolina Central.

St. Johns, Lake Weir & Gulf.—This Florida line has been surveyed from Jacksonville to Anclote *via* Palatka, Lake Weir, Oxford, Argo and Hudson, about 200 miles. Right-of-way has been secured and it is expected to let contracts next fall. E. C. HOOD, Lake Weir, Fla., is President.

Madison & Southeastern.—This road is projected from Madison, Ind., to Danville, Ky., *via* Shelbyville. WM. M. CRAVENS, New Castle, Ky., is President.

Hartford & Morganfield.—This is a Kentucky line, projected between the points named above.

Chesapeake, Decatur & New Orleans.—Surveys are reported in progress on this line between Shelbyville, Ky., and Murfreesboro, Tenn.

Mobile, Hattiesburg & Jackson.—This company has been chartered by business men of Mobile, Ala., to build from that place to Jackson, Miss., *via* Hattiesburg. The company will utilize the old roadbed of the Mobile and Northwestern, which is graded for 20 miles from Mobile.

The Northwest.

Existing Roads.—*Red River Valley.*—The work on this road, and the obstruction tactics of the Canadian Pacific and the Dominion Government, are the all absorbing topic in Manitoba at present. The contractors have pushed the grading with all possible speed, and it is now practically completed from Winnipeg to the boundary, and tracklaying has begun. All sorts of extravagant rumors have been in circulation. It has been reported that Sir JOHN MACDONALD, the Dominion Prime Minister, would order the building of the road to be resisted by an armed force, but this is generally characterized as a piece of folly which the Canadian statesman is far too shrewd to be guilty of. The injunctions against crossing lands owned by parties in the Canadian Pacific interest have been ignored. While the Canadian Pacific and the Dominion Government have the law undoubtedly on their side, and the Manitobans are certainly to a greater or less degree proceeding illegally, the latter party have the much more effective backing of public opinion, and there is not much doubt that the Canadian Pacific will have to relinquish its monopoly of Manitoban traffic, and obtain such pecuniary satisfaction as it can from the Dominion for this breach of contract.

Willmar & Sioux Falls.—Graders are pushing the work on this line between Pipestone City, Minn., and Sioux Falls, Dak.

St. Louis, Alton & Springfield.—Bonds have been issued by the company for $1,500,000 for completing the purchase of the road from the Wabash and extending the road from Alton to Elsah and Grafton to Quincy.

St. Paul, Minneapolis & Manitoba.—The final location of the Pierre, Duluth & Black Hills road from Aberdeen Dak., to Pierre, on the Missouri river, about 125 miles is about completed, and contracts are to be let soon.—A petition has been presented by the farmers of Towner county, Dak., for the company to lay the iron on the 12 mile spur which was graded last fall from Church's Ferry to Cando. It is said that there are 800,000 bushels of wheat in the country about Cando now ready to market, and railroad facilities are desired. Unless the Manitoba lays the track soon, an effort will be made to induce the Northern Pacific to extend the Jamestown & Northern line to Cando from Minnewaukan, a distance of 30 miles.—New car shops are to be erected at St. Cloud, Minn.

Minnesota & Northwestern.—A new project of the company, which is to be surveyed and put through at once, is a line running from Sycamore, Ill., *via* Moline and Rock Island, to Keithsburg on the line of the Central Iowa.

Chicago, Burlington & Quincy.—Forty miles of new road have been opened for traffic in Nebraska, from Central City northwest to Greeley.

Chicago & Northwestern.—The Sioux Valley road has been opened for business from Kingsley, Ia., to Moville, about nine miles.—On the extension from Faulkton, Dak., west, track is laid to the Potter county line, 25 miles from Faulkton, and work has stopped till more rails can be obtained.

Ohio & Mississippi.—It is proposed to extend the branch which now terminates at Beardstown, Ill., to the Mississippi river opposite Keokuk, Ia., about 60 miles.

New Projects and Surveys.—*Grand Marais & Vermilion.*—This company has been chartered in Minnesota by CHAS. E. MONROE and others, of Milwaukee, Wis., to build a railroad from a point on Lake Superior near Grand Marais, northwest to a point on the Vermilion iron range, and thence north to the International boundary. The capital stock is $2,000,000.

Missouri River, Roscoe & Duluth.—This is a Dakota project with headquarters at Roscoe, and the line proposed is from Roscoe, through Edmunds and McPherson counties to Leola. F. M. HOPKINS is President.

Dubuque, Kansas City & Southwestern.—This company has been organized under the auspices of the Dubuque, Ia., Board of Trade. The proposed route of the road is indicated by the title. J. P. FARLEY, of Dubuque, is interested.

St. Louis, Grand Tower & Southern.—This Illinois line is under survey. H. A. SCHWANECKE is Chief Engineer.

Lake Superior & Southwestern.—The preliminary survey of this Minnesota line has been completed and work is in progress obtaining subsidies and rights of way.

Eastern Illinois & Indiana Line.—This company has filed a charter in Illinois for a road from the Indiana State line to a point on the Chicago & Eastern Illinois near Beecher.

The Southwest.

Existing Roads.—*Chicago, Milwaukee & St. Paul.*—On the Kansas City extension the tracklayers have reached Excelsior Springs, 20 miles from Kansas City, and it is expected that trains will be running over the whole line by Oct. 15.

Chicago, Rock Island & Pacific.—Track is now laid and the line is in operation to Caldwell, near the southern boundary of Kansas. About 300 miles of line is under contract to be finished by the end of the year, which will make a total trackage of the Chicago, Kansas & Nebraska, including the leased line between Kansas City and Topeka of over 1,000 miles, constructed within a period of 18 months. The Denver line, the Texas line, and the New Mexico or Pacific extension will probably furnish as large a mileage for next year's construction.

Union Pacific.—The locating survey of the McPherson, Texas & Gulf road is now completed from McPherson, Kan., *via* Hutchinson and Kingman, to the South line of the State, and heavy subsidies have been secured all along the line. It is thought the work will be put under contract very soon.

Missouri Pacific.—The Taylor, Bastrop & Houston line, whose completion to La Grange, Tex., was noticed last week, is to be pushed on at once to Houston and Galveston.—Work is in progress obtaining right of way for a line from Henderson, Tex., *via* Center to Alexandria, La.—The Inter-State railroad from Leroy to Gridley, Kan., is finished and will be operated in connection with the St. Louis & Emporia line.—The Denver, Memphis & Atlantic has been opened for traffic from Cedarvale *via* Winfield to Oxford, Kan., and from Stafford to Larned, Kan.—Work is in progress on the yards, round house, and machine shops at Nevada, Mo.—On the Bald Knob and Memphis extension in Arkansas, grading is completed and the track is laid to the St. Francis river, 30 miles. The entire line, 81 miles in length, is expected to be in operation by Nov. 1.

Atchison, Topeka & Santa Fé.—The St. Joseph & Santa Fé has effected its organization and work begins at once on the grading of the line, which is to run from Atchison, Kan., to St. Joseph and Carrollton, Mo.—A spur line has been surveyed from the Chicago, Santa Fé & California to Edina, Mo. The line is five and three fourths miles long, and will probably be constructed.—On the extension to Weatherford, Tex., of the Gulf, Colorado & Santa Fé, track is laid to Cresson at the crossing of the Fort Worth & Rio Grande, 20 miles from Cleburne.

St. Louis, Kansas City & Colorado.—The ownership of this line has now been formally transferred to the Santa Fé managers, and by the amended charter filed by the company it is seen to be the intention to build a network in southern Missouri similar to that which they have found so profitable in eastern Kansas. The charter covers eight routes and over 900 miles of lines. Many of these parallel the Missouri Pacific and it looks as if the Santa Fe intended to get even with that company for its competition with their Kansas monopoly. But with the fertile soil and abundant resources of Missouri properly developed, there will be an abundance of business for both.

New Projects and Surveys.—*Little Rock & Alexandria.*—This road is proposed from Little Rock, Ark., to Alexandria, La., about 250 miles, and right-of-way and subsidies have been secured. Surveys are to begin soon and it is hoped to push construction at an early date. There will be three bridges over navigable streams, but the work is generally light. B. W. JOHNSON, Camden, Ark., is President.

El Dorado & Southern.—This Arkansas company has filed its charter to build a line from Camden to El Dorado, about 25 miles. JESSE B. MOORE, of El Dorado, is interested.

Arkansas & Grand Prairie.—This is another Arkansas scheme of no modest proportions. The proposed line is to run from Springfield, Mo., south to Morgan City, on the Gulf, between five and six hundred miles. The usual "eminent engineer representing an English syndicate" is reported to be looking over the proposed line.

Kansas, Salt Plains & Texas.—This company has been chartered in Kansas to build from McPherson to the south line of the State, about 170 miles, and an indefinite distance beyond. MARQUIS M. TOOLE, Hammond, Ind., is one of the incorporators.

Texarkana Northern.—It is reported that the survey of this line, which is to run from Texarkana, Ark., to Fort Smith, is now in progress. It would not be strange if this line eventually turned out to be a Santa Fé road.

Kansas City Fort Smith & Southern.—This company is endeavoring to secure a subsidy at Fort Smith, Ark. M. A. CLAY, Neosho, Mo., is President.

Rocky Mountain and Pacific.

Existing Roads.—*Southern Pacific.*—A very important project which C. F. CROCKER in his testimony before the Pacific Railway Commission reported as under serious consideration by the company, is for the abandonment of the present line across the Sierra Nevada mountains, and the construction of a tunnel through the range. The line follows the course of an old survey, leaves the present line near Towles, and follows the south fork of the American river through a deep canyon. The tunnel through the range would be about four miles in length and would emerge in the Cold Stream canyon at its eastern end, down which the line would run, reaching the present road at Truckee. It is also proposed to utilize this tunnel for a great hydraulic scheme to carry an enormous stream of water from Lake Tahoe into the Sacramento Valley for use in water supply and irrigation. While the first cost of the enterprise would be large, it would do away with maintaining and operating the present expensive overhead line, and in connection with the hydraulic scheme it is thought would prove very profitable.—The Capay Valley road is graded for about 18 miles. On the Willows and Mendocino road about 24 miles are graded, which is all the company will build at present. A survey has been completed from Shorbs's station, near Los Angeles, *via* Pasadena to San Bernardino. Surveyors are working on a line from Sycamore to Porterville, running through Visalia.

San Francisco & North Pacific.—Grading is about finished on the Marine and Napa line and work on the two tunnels of the Cloverdale and Ukiah road is being pushed.

New Projects and Surveys.—*Cortez & Dolores Valley.* This Colorado road is projected to run from Cortez to Rico, about 50 miles. The line will open up the Montezuma valley, which is to be irrigated and will rapidly be settled. The preliminary surveys have been made and the line run has been approved by the Secretary of the Interior. M. J. MACK, Cortez, Col., is Chief Engineer.

Rocky Fork & Cooke City.—This Montana project has gravitated into the hands of the Northern Pacific, and it is supposed that the line will soon be placed under construction.